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ANNOUNCEMENT

To a community groaning under an ever increasing weight of periodical literature, a new magazine is forced to present itself in an attitude of apology. Like those college men with whom its interests are to be most closely bound, The Technology Review must make plain its purposes, its capacity, its determination to be useful, before it can expect to receive recognition from a public too busy to be indulgent. Realizing this, and mindful, too, of the spirit and traditions of the Massachusetts Institute of Technology, The Review neither throws itself upon the charity of its friends nor prays them to be blind to its shortcomings. Doubtless it will need indulgence, doubtless its attainment will fall much below its aspiration; but if it does not so far succeed in its attempt as to gain support through feelings other than those of simple friendliness, the existence of The Review cannot be too quickly ended.

Few appreciate how vast and complicated the interests of the Massachusetts Institute of Technology have become. With students, past and present, in every State, and in almost every part of the world, occupied in all manner of work and every civic duty; with studies of great range and courses of wide divergence; with always new and ever more complex problems of education crying for solution, the Institute obviously stands in need of a clearing-house of information and thought, to increase its power, to minimize

waste, to ensure among its countless friends the most perfect coöperation.

Such a clearing-house THE TECHNOLOGY REVIEW purposes to be. The scattered news, the isolated suggestions and criticisms, the wide-spread evidences of the soundness of Institute teaching, will here be gathered and, in orderly form, put upon permanent record. The Corporation, the Faculty, the graduate, the "special," the undergraduate, will in these pages learn more of one another, check each the other's work, and realize better what all must do to serve the high ends of the Massachusetts Institute of Technology.

It is this feeling of solidarity that, above all, THE REVIEW hopes to promote; for through such a spirit alone can be created a binding force sufficient to overcome that disruptive tendency which the rapid growth of the Institute and the multiplicity of its interests threaten to induce. Buildings and laboratories scattered over a considerable area, classes so large and so sub-divided that classmates have little opportunity of wide and close acquaintance, absorption in studies leaving little leisure for social intercourse, professional demands which lead the alumni to the ends of the earth, — all these things tend to rob the Institute of that personal, intellectual, and spiritual cohesion which is essential to the well-being of every college.

With such objects in view, the course of THE TECHNOLOGY REVIEW is clear. In its longer and more formal articles of description, of friendly criticism, of free discussion, it will follow the amazing growth of the Institute of Technology, suggest new directions of expansion, and call attention to the large, immediate problems of education confronting every college, but pressing with unusual urgency upon those which, like this, are pioneers.

Less formally will be presented the news of Institute life as it relates to the administration, the teaching staff, the students, and the public. The work of graduates and non-graduates will be recorded by classes, and these records will deal not simply with their professional successes, but with their achievements as men, as citizens, as scholars. The literary chronicle will be kept through lists of publications and through reviews of books; while the social side of the Institute will be presented through reports from the Alumni Association, the subsidiary graduate associations, the Technology Club, and the undergraduate organizations. Portraits, views of buildings, plans, and other illustrations will be used in such measure as seems desirable. In short, nothing concerning the life of the Massachusetts Institute of Technology will fail of recognition, and in a shape to make it of genuine interest to every one having any relations, however remote, with this great institution.

The Association of Class Secretaries, by which the conduct of THE REVIEW has been undertaken, while arrogating to itself no extraordinary powers, is clearly the body best able to conduct a magazine upon the lines that have been indicated. Including, as it does, men of every class, from the graduate of 1868 to the undergraduate of 1899, embracing representatives from the Corporation, the Faculty, the Alumni Association, the non-graduate body, and the students, having at command the machinery of class organization, the Association touches Institute life at every point and has within itself the possibility of reporting with due proportion every phase of the problem involved in the upbuilding of an institution of its magnitude and complexity.

In the selection of a committee of publication and an editor the same principle of representation has been kept in mind. Therefore, if THE REVIEW fails to be broad, if

it sacrifices things of general to those of narrow interest, if it inclines to become a technical journal or a student record, or a petty critic of details, if it grows to be in any way unrepresentative, the fault will lie with the execution, not with the aims, of its projectors.

Those projectors have but one end in view: the welfare and advancement of the Massachusetts Institute of Technology. They appeal, therefore, for support, to every one who has any interest, past, present, or future, in that college, and they feel sure that their appeal will not be vain. There is a singular heartiness in Institute men, a liberality of thought, a breadth of interest, a freedom from cliques, which render them, busy and widely separated as they are, most friendly and helpful to whatever promises to be of service in this direction. Already has THE REVIEW received most noble earnest of this spirit. The Corporation and Faculty, through committees, the Alumni Association, through its officers, the student body, through its *Tech* and *Technique* boards, have given it most cordial aid and counsel. Coming now before the larger bodies which have been thus represented, appearing in its first issue to a still wider public bound to the Institute by many ties, THE TECHNOLOGY REVIEW asks that, at least, its aim may be encouraged, and that this public, already seeking individually to be of service to the Institute, unite with one another and with this magazine to make the Massachusetts Institute of Technology, not simply an ever more effective school of industrial science, but a true University, great in every meaning of that term, and differing from others only in resting fundamentally, not upon the Humanities, but upon the pure and applied Sciences.

JAMES MASON CRAFTS

"THE great business of a college president," as defined in 1846 by Josiah Quincy, "was to overlook the conduct of the young men, and by timely interference prevent bad habits, detect delinquencies, and administer reproof and punishment, in all instances in which he could, apart from the faculty." Happily for the cause of education, the older colleges have long outgrown this curious tradition, the influence of which, by rare good fortune, the Massachusetts Institute of Technology has altogether escaped. "The great business of a college president," as interpreted by President Rogers and his successors, is one to tax to the utmost limit the resources of a great administrator. As the head of a complex organization, which touches at many points the life and work of the community it serves, the college president to-day stands between that organization and the community; quick to perceive and to respond to the changing needs of each in its relations to the other. Where these relations are concerned, he must feel the trend of public thought as a helmsman feels the pressure of the wheel, and as far as may be direct that thought to sound conclusions. Within the institution problems of ways and means, before which courage shrinks, must often be solved by faith alone, questions of policy must be decided, though the decision may determine the measure of the institution's influence, and when the claims of all departments are urged by earnest advocates, there must be preserved that nice adjustment which secures to each its due proportion. Above all is the duty of building up and sustaining the spirit of enthusiasm and coöperation which is the life and soul of any college, the uniting and compact-

ing of all forces within and without the college which may help on its work.

In view of these multifarious demands before which any man of business might well pause, and bearing in mind the popular idea that a scientific man, by reason of his training, is necessarily not to be regarded as a man of affairs, it is a matter of no little interest to note how frequently in recent years the duties of this position have fallen upon scientific men, and particularly upon those men whose department of science has been chemistry. In the early days of the Massachusetts Institute of Technology Professor Eliot gave up the chair of chemistry to assume the presidency of Harvard. In more recent times Doctor Drown has left us to become president of Lehigh. The names of Doctor Morton, the head of the Stevens Institute of Technology, Professor Chandler, dean of the Columbia School of Mines, and Doctor Schaeffer, chancellor of the University of Iowa, come at once to mind.

President Crafts brings to his office a reputation as the pupil of Bunsen and Wurtz, as the friend and associate of Sainte-Claire Deville, Dumas, and Friedel, and as the author of numerous papers, which have placed him in the front rank of organic chemists. He is no stranger to the Institute, but has the sympathy and comprehension born of old acquaintance with its aims, its methods, and its alumni. Like the college itself, his first inspiration was derived from William Barton Rogers.

James Mason Crafts was born in Boston, March 8, 1839. His family is one well known to the older residents of Boston, his father, R. A. Crafts, having been a merchant of the city, and a pioneer in the manufacture of woollen stuffs in New England. His mother was Marianne Mason, the daughter of Jeremiah Mason, a

famous lawyer of the period, who was often opposed to Daniel Webster, and who served as United States Senator from New Hampshire, from 1813 to 1817.

The boy grew up in the midst of the pleasant social and intellectual life of the city. He first attended Mr. Kidder's School in Bowdoin Square, and then one kept by Mr. Sullivan, near Park Street Church, where he prepared for the Boston Latin School. His taste for the natural sciences and for experiment developed early, and soon led him to leave the Latin School to pursue general studies with Dr. Samuel Eliot, under whose instruction he remained for a year, until ready for college.

Boston, in 1855, was the centre of an especially stimulating intellectual life to which so active a mind as that of young Crafts could not fail to respond. There was something of the eager interest in the more popular forms of science which had manifested itself a little earlier in London, where the streets leading to the Royal Institution were blocked with the carriages of people of fashion on the days of Faraday's lectures. Agassiz, Cooke, and Rogers, among others, were giving courses of lectures which the boy attended. He was still more fortunate in coming into direct personal contact with President Rogers, who then lived on Temple Place, and frequently visited the Crafts, where he used not infrequently to try simple experiments in illustration of some point raised in conversation. Just as Giotto gave evidence of his ability by drawing perfect circles with one free sweep of the brush, so President Rogers would sometimes show his skill with one stroke of the crayon. An early consequence of the boy's natural scientific tastes and the stimulus of such surroundings was the fitting up of a laboratory. The Crafts' house on Tremont Street was a very wide one, having a frontage of

fifty feet, and here, in a large attic room, he attempted such experiments as he had seen tried by Cooke or Rogers, and made others which he found described in Doctor Hare's Chemistry, all doubtless to the mingled pride and trepidation of the family. As a result of one of the first of these essays the boy found himself one night surrounded by glowing eyes, which effectually banished sleep, until it was discovered that they had their origin in numerous little pieces of phosphorous which had become scattered around his bedroom.

The Lawrence Scientific School had been recently founded in Cambridge by Abbott Lawrence, with Professor Hosford at the head of the chemical department. Young Crafts's tastes turning naturally in its direction, his original intention of taking a collegiate course was abandoned, and he entered the Scientific School, from which, in 1858, he was graduated. The course at that time was one to throw a young man much upon his own resources. There were occasional recitations covering the material of Regnault's Chemistry, a two-volume English translation of which had appeared in 1853, but for the most part the time of the students was devoted to laboratory work much after the manner of their own inclinations. At this period the immensity of the undeveloped mineral resources of the United States began to be recognized, and the experience of the pioneers of 1849 was still fresh before the country. The profession of mining engineering was one which seemed to afford great opportunities, and young Crafts was led to spend a post-graduate year at the Lawrence Scientific School in the study of engineering. The next year, 1859, he went to Freiburg, Saxony, to pursue his study of mineralogy and mining engineering. Plattner's fame as a metallurgist, and especially his *Probirkunst mit*

dem Löthrohr was bringing to Freiburg students from every part of Europe, although Crafts was one of the first Americans to take this course. Plattner had died in 1858, but his influence and methods still prevailed in the celebrated School of Mines, which remained the foremost institution of its kind. An unusual variety in the mineral products of Saxony afforded abundant opportunity for the practical study of mining and the processes of metallurgy. Silver, iron, copper, bismuth, lead, tin, zinc, and cobalt were and doubtless still are all worked in the little kingdom.

With growing knowledge and in the midst of these opportunities there came to the young man a recognition of his fitness for the pursuit of pure chemistry, and after a year at Freiburg he removed to Heidelberg, where he came at once under the influence of Bunsen, and later into close relation with that great teacher. Bunsen and Kirchhoff had just begun their classical research in spectroscopy. Cæsium had been discovered in the Durkheim waters with a single bisulphide of carbon prism, and the arrival of a new three-prism instrument from Fraunhofer stimulated Bunsen to greater efforts. The recognition of Rubidium followed while Crafts was Bunsen's assistant, and the occurrence of Cæsium in the waters of Nauheim was for the first time demonstrated by Bunsen late one night when working in the laboratory with his pupil.

In 1861 the fame of Wurtz as the foremost exponent of the theory of types, the discoverer of the glycols and compound ammonias and as the successor of Dumas and Orfila, drew Crafts to Paris, where he enrolled himself as a student in the *Ecole de Médicine*. Here he remained four years under the direct instruction of Wurtz, to whose teaching and inspiration the course of his later work is mainly due. He returned to America in 1865, examined some

silver mines in Senora, and travelled for a year through Mexico and California. Returning to Boston, he equipped a laboratory in the house formerly occupied by Professor Hosford, and soon thereafter discovered the ethers of arsenious and arsenic acids. He was married in 1867 to Miss Clemence Haggerty and has a family of four daughters. During the same year Cornell University was founded, and upon Professor Crafts as dean of the chemical faculty fell the duty of organizing the chemical department and of planning and equipping the laboratory. Professor Crafts had even at this time grasped the laboratory idea in teaching, and did not hesitate to organize his department on the lines which that idea demanded. His course in "Qualitative Analysis," now in its sixth edition, was published during his connection with Cornell.

President Crafts first came to the Massachusetts Institute of Technology in 1870 to occupy the chair of chemistry as the successor of Professor Storer. He devoted himself actively to the service of the Institute until 1874, helping to shape its methods and to further its spirit, but in that year his health broke down and he found himself obliged to go abroad. He retained, however, his connection with the college as a non-resident professor until 1880.

The period from 1874 to 1891 was, perhaps, the most productive in Professor Crafts's career as an investigator, and its fruits have shown him to be a true master of science and one of the first among organic chemists. These years were chiefly spent in Paris in chemical and physical researches at the *Ecole des Mines*. Independently or in collaboration with Professor Friedel he carried out a brilliant series of investigations, covering the ethers of silicon and the compounds of that element with other organic radicles, the reactions of aluminum chloride with a large number of

substances and the density of the halogens at high temperatures. Of the use of aluminum chloride for the purposes of organic synthesis, as proposed and developed by Friedel and Crafts, Baeyer has remarked that the method has been so fruitful and its results so varied that an account of them reminds one of a fairy tale. It has been perhaps the most prolific of all modern synthetic methods. The study of the halogens led to the important discovery of the gradual dissociation of the iodine molecules into monatomic molecules at temperatures above 600° C.

Although first of all a chemist, Professor Crafts has shown his versatility and grasp of the scientific method by notable work in physics, especially in the department of thermometry. He is the inventor of a special form of hydrogen thermometer, and, in recognition of the merit of his method of reducing the inaccuracies of mercurial thermometers by preventing the slow displacement of their fixed points, he was awarded the Jecker prize of two thousand francs by the French Academy of Sciences, and made a Chevalier of the Legion of Honor by the French Government.

Professor Crafts again returned to Boston in 1891, and was brought at once into close relationship with the Massachusetts Institute of Technology. He continued his chemical and physical investigations in the laboratories of the Institute and was elected a member of the Corporation. In 1893, "to the great gratification of the Faculty of the Institute, Professor Crafts consented to take charge of the instruction in organic chemistry," and to quote further from President Walker's report of that year, "The accession of a chemist of Professor Crafts's reputation, a teacher of his experience and exceptional powers of inspiring interest and enthusiasm on the part of the students, marks an era in the

history of the Institute." Professor Crafts became the head of the Department of Chemistry upon the departure of Doctor Drown to assume the presidency of Lehigh, and was chosen chairman of the Faculty in January, 1898, soon after the death of President Walker. In the autumn of that year Professor Crafts was elected president of the Institute.

President Crafts is a member of the prominent chemical societies of this country and Europe; he is a corresponding member of the British Association for the Advancement of Science and a member of the National Academy of Sciences. He received the degree of Doctor of Laws from Harvard in June, 1898. The degree was conferred with these words from President Eliot:

"James Mason Crafts — Forty years ago a graduate of the Lawrence Scientific School, a lifelong student of chemistry, the president of the most successful school of applied science in the United States, the Massachusetts Institute of Technology."

THE FUNCTION OF THE LABORATORY

As a powerful educational agency, the laboratory needs no advocate; but the question must often recur, What is its true function; and how may this be best developed? It is to this inquiry that attention is here invited, but to only that phase of it which relates to education for the technical professions.

To understand the objects to be accomplished by the laboratory in the technical school, we need to hold clearly in mind the aim of such an institution. Whether called a Technical School, an Engineering School, a School of Applied Science, or an Institute of Technology, the character of these institutions is best implied by the terms applied to our own institution by its founder, William Barton Rogers; namely, "School of Industrial Science," and "comprehensive *Polytechnic College*." The direct aim of these schools, one and all, should be to send forth men and women educated to the point of beginning upon the technical professions, — Engineering, Architecture, Applied Chemistry, and so on. Now although the "technical" is that which pertains to the arts, and although "technology" is that body of knowledge which comprises the arts, still he whose occupation is exclusively the practice of an art (other than the fine arts) is an artisan, not a member of the technical professions. The civil engineer must often practise surveying, but a surveyor may be no engineer. The education of the artisan is the province of the Trade, Industrial, or Textile School, not of the Technical or Engineering School, in the broad sense in which those terms are now customarily employed. The work of the artisan is to construct, — to apply known proc-

esses or machines to the production of some object or end of industrial value; in other words, to carry out his art. The work of the technical professions, on the other hand, is the direction and extension of the application of the arts, together with a far higher function, — the development of the arts, that is, of technology. Now technology, in its hand-in-hand progress with science, has largely passed from a mass of empiricism into a body of applied science, — of science applied to industrial operations. Each year witnesses the incorporation of higher scientific knowledge into the arts, to the extent that one may almost say the science of yesterday is the technology of to-day.

The chief function of the engineer is, then, to bring pure and applied science to the industrial service of mankind. It is for him to analyze the ever new industrial problems, bringing to bear upon them the scientific method of inquiry, and applying to their solution all related scientific as well as technical knowledge. And what is true of the engineer is equally true of the members of the other technical professions with which we have here to deal. Indeed we may very properly employ the term engineer to denote the members of all of these professions, since the common aim of all of them, the military engineer alone excepted, is *utilization of science, the application of science to industry.* If in these few words I have rightly summed up the strictly professional function of the engineer, it is plain that the acquisition of science, both pure and applied, and of its methods, must be the great aim of his student career.

The engineer should have the skill of the artisan in his own line of work, at least to the extent that he knows what can and cannot be done by the skilled workman. Apart from the training of hand, eye, and mind, involved in its acquirement, this knowledge will almost certainly be

of direct service to him in the early stages of his career, and will command, early and late, the respect of his associates and subordinates. It is also an absolute essential in any competent designing of new work. Obviously, however, the engineer's acquaintance with applied science must be far wider than the range of his manual skill, and, while not supplanting it, is of much more importance. In like manner, the mastery of pure science and its methods is to him of higher value than even its applications, vital as these are. Moreover, modern technical practice is progressing with such acceleration, and every branch of scientific knowledge is so diffusing itself into every line of engineering, that the coming generation of engineers will find the most thorough command of science which they can obtain a none too efficient aid in the keen competition of their future practice. Breadth of view, opportunity, ingenuity, and "common sense" being equal, he who is a master of science will distance competitors. Science, then, and its methods must rank first; applied science, second; artisan skill, last. Experienced engineers will, I believe, heartily endorse this proposition.

Lest it should be remarked that in this brief comment on technical education no allusion has been made to other than scientific training, it may be said that we are now dealing, not with the broad topic, but with only a single aspect of it. The appeal for general culture cannot be too strongly urged. The thoughtful addresses of Mr. George S. Morrison are effective presentations of the unanswerable argument for much more than a purely technical education for the engineer. We must also not overlook the certainty that many graduates of the technical schools do not pursue a technical career. To them the truly educational power of their student work, rather than technical attainment, will be the measure of its value.

In education for the technical professions, the inculcation of the scientific method of inquiry into new problems is of even greater importance than the accumulation of facts; for the application of this method with practical sagacity is the one highroad to successful encounter with every problem of nature, whether of the most practical or of the most abstract character. Precisely here lies the great strength of the laboratory; for although the scientific method enters into all branches of scientific work, nowhere else does everything so combine to its enforcement as here. Eye, ear, and hand are brought into action to deepen and vivify the mental impression. Material things, energy, and force, with their immutable laws, confront the student, inspire his imagination, excite interest, and impress the memory; while the sense of gaining mastery over the implements, machines, and materials of his profession will give earnestness to purpose and permanence to impressions.

The following considerations with respect to the laboratory do not assume to criticise existing methods, or to present novel ones to the experienced teacher. The effort necessary to keep the laboratories of a great institution in the van of progress cannot come from the teaching staff alone; the highest ideals and aims must be clearly apprehended and endorsed by those also who are responsible for pecuniary and moral support. Nor is it only from this source that aid and inspiration should be forthcoming. Most effective stimulus should come likewise from those who, from their work as students, and from later professional experience, have a knowledge of the value, merits, and defects of the laboratory instruction. The object, therefore, in here giving expression to purely personal views is to indicate what seem to me to be important functions of the laboratory, together with some of its

possibilities and dangers, in the hope of winning for them wider appreciation, and of inciting active interest and coöperation among those who have at heart the interests of our own Institute of Technology.

The laboratory may advantageously be viewed in three aspects: in its relation to the student, to the instructor, and to the professions and community at large.

As to the relation of the laboratory to the student, aside from training in the use of tools in the "Mechanical Laboratories" or workshops, its most elementary function in the college of industrial science is to aid the student in his grasp of the phenomena, laws, and principles of science. The performance of an illustrative experiment with his own hands and in a spirit of real inquiry is worth, many times over, the same length of time in study of a text-book. It gives concreteness and exactness to his ideas, corrects misapprehensions, presents new points of view, and promotes inquiry, interest, and confidence. It must be remembered that the experiments possible to the student *illustrate*,— they do not *prove*. To deduce the law of universal gravitation from the fall of an apple, or to "prove" the law by the fall of a stone, is all delightfully simple, but it is not science. The cultivation of the habit of false inference is one of the vicious features of too much of elementary laboratory literature. This subversion of logic and the logical faculty is antagonistic to the very spirit of science; for science is nothing if not logical.

Although it may be that, eventually, some of this work can be left to the secondary schools, still, I am strongly of the opinion that in every technical institution which gives a course in general physics, duplicate sets of the more important lecture apparatus should be accessible to the stu-

dents for (optional ?) individual practice under competent supervision. Such work would make large inroads upon the time of an instructor with even a few students; with a large number, free to work and question, his full time would be needed. The opportunity thus afforded would, if optional, be disregarded by many, possibly by the majority, either from lack of interest, or from real or fancied pressure. But to the interested student, the special student of physics, and to teachers improving an opportunity for further training, the work would be of great value. Such a course of instruction is capable of being made a most valuable adjunct, not only to the teaching of physics, but to the influence of the institution on the educational work of the country. One can but regret that the demands of a service so unquestionably useful are overshadowed by the greater urgency of other features of the work in physics.

The remark that some of this work may be left to the secondary schools should be modified by the comment that, if the course just outlined is omitted from the technical college, much of its effect will be lost altogether; for the influence of maturity of mind and the choice of a career are wanting. It is true that, with what he may have had in the lower schools, and with his later quantitative work in the physical laboratory, the student may obtain a good command of the elements of the science; but the opportunity for doing things with his own hands at the time when he is reading and hearing about them, of trying and questioning for himself, is what most real technical students desire, and what is in harmony with their mental trend and the nature of the professions at which they aim. Their later work in the physical laboratory cannot afford exactly this opportunity, both because it is in general not

concurrent with their lectures and recitations, and because it cannot cover the same ground.

As to chemistry, the statements just made concerning physics are true to a considerable extent, but there is also a point of marked difference. The knowledge of the phenomena, materials, and operations of chemistry is more intrinsically apart from daily experience than that of the corresponding elements of physics. Thus, in chemistry, without experimental work keeping pace with descriptive study, there is small chance of clear or permanent acquisition of the fundamentals. And without that, advance is painful and imperfect. Therefore, until the necessary quality of work can with certainty be obtained from the secondary schools, the technical college must teach, or re-teach, the elements of general chemistry in its laboratories, — at least to students making this a professional study. Moreover, this special body of work stands forth above all others in adaptability to that sort of rigorous training in scientific observation, manipulation, and method which should characterize the very outset of a technical course, serving at once as a challenge and a test. Comparative simplicity of materials, apparatus, and operations; the limited space needed; the directness with which the false result can be confronted with the true and stubborn fact, are some among many reasons for its adoption; and they are well sustained by the success of its application.

The great function of the laboratory in its relation to the student is, however, the inculcation of the scientific method. This embraces the arts of observation, experiment, and measurement, analysis of the problem in hand; plan of the mode of procedure; design of apparatus with due regard to corresponding accuracy in all parts of the work, as well as to the mere accomplishment of

the measurements; also modes of computing, discussing, digesting, and presenting results, and the preparation of reports.

In the endeavor to obtain a broad view of the way in which this great end may be promoted in the technical college, there are certain principles to be considered. Foremost among these is the fact that, although it is the scientific method which is to be cultivated, we have to do with students in a school of *applied* science, and not of *pure* science. This must be kept in mind in the plan of work and in the details of daily instruction from beginning to end. Its importance lies not only in the intrinsic merit of the lines of work which it suggests, but also in the opportunity it affords of employing instead of antagonizing one of the greatest of educational forces, the enthusiasm of the student. Most young men who go to a technical college enter it with a more or less definite purpose as to their life-work, the result of inherited or acquired mental traits. Their intention, often their ambition, is to take an active part in one of the professions having to do with the great creative industries of the world, which are contributing so powerfully to its material advancement. Their taste or disposition is as distinct from the purely business or commercial impulse, on the one hand, as from the purely literary, on the other. It is nearer akin to the scientific disposition, but differs essentially from it, in that its motive is the creative desire rather than the love of knowledge and its mastery for its own sake. These young men look at their educational training as a means to the end which they have immediately in view. The majority of them will work with enthusiasm and without stint upon whatever they recognize or can be made to recognize as contributing to that end, but by their very earnestness they

are intolerant of digression from the plain highway. Nothing tends to more effectually annul the effectiveness of an otherwise able teacher than to disregard or antagonize this spirit. No course of work in the laboratory, however intrinsically good, but will be shorn of most of its usefulness if, in its plan and in the daily personal instruction, this attitude of the student is not duly invoked. For, I repeat, this spirit is a power to be turned to service, not to be opposed. If this proposition is not of the freshest, it still awaits its full application. Appreciation of the fact that the sum of two forces is more effective than their difference was not original with Nansen, but he was wise enough to act in accordance with it. I do not mean that education should pander to that narrowness which cannot see the practical beyond the driving of a nail. Neither do I mean that the student is to be the censor of the details of his own course of study. But I do insist that he is entitled to know, and further that he should be made to see, that every part of his work has a well-considered bearing on his professional aims, and also as far as possible what that bearing is; and I conceive that, in the superabundance of educational material, a selection is possible which will commend itself alike to the experienced member of the technical profession, to the educator, and to the advocate of pure science, and which can, therefore, be made to command the hearty enthusiasm of the student.

The courses in the technical college should be not merely strong, they should be inspiring. Nowhere is this more important than in the laboratory. A great line of possibilities towards this end is opened up by the following consideration. While the spirit of research in pure science is the desire for the acquisition of knowledge for its own sake, as contrasted with that of the industrial arts, which is

to operate processes and machines yielding merchantable products or information; still, investigation for the purpose of discovering new processes for the arts, or for developing and perfecting existing ones, must employ the scientific method. The fact that the methods of study actually pursued in much "practical" work of this kind are the reverse of scientific in character, and are often actuated by sordid motives, is not counter to this assertion. In other words, the application of the methods of scientific investigation is the means for the advancement of technology. And if so, then *the scientific investigation of technical problems*, or rather, of problems indicated by the needs of technology and the industrial arts, *must assume a leading place in education for the technical professions*. It will widen and fix the student's scientific and technical knowledge at the same time that it impresses the scientific habit of thought and work, both of which are foremost requisites among the qualifications for modern professional practice; and it is doubly effective as a method because it enlists the justifiable enthusiasm of the student.

In putting this view into practice, the intimate dependence of all the industrial arts upon the science of physics must be duly recognized. Hence, after the work in chemistry and physics indicated above, the step which should immediately follow for all technical students is a course of quantitative work in the physical laboratory. This course should deal with the fundamental instruments and methods of the art of measurement, and should apply them to exclusively physical problems. The most scrupulous care should be given to even minor details in the keeping of records and the performance of computations, and the student should be made to see the real significance of these minor matters, and should not be permitted to regard

them as arbitrary pettiness. Every piece of work should be, as far as possible, in the form of a scientific problem to be solved, and should illustrate some one or more distinct instruments or methods of observation or experiment, or some valuable mode of discussing or digesting results. The illustration of physical laws furnishes the material for the problems, with the obvious incidental advantage of enforcing them on the attention. The course should be the application of the scientific method to scientific problems, in a strictly scientific laboratory. This may seem contradictory to the attitude just taken towards the investigation of technical problems, but it is not really so. For the fundamental measuring instruments and methods of discussion in technical work are those of physical science. And although these are now engrafted on all branches of science and the arts, they will unquestionably receive more appropriate and more adequate presentation in the physical laboratory than elsewhere.

There need be no difficulty in holding interest in such a course. There will be none with well-planned work *not too long deferred in the curriculum*, provided that the professional department in which the student is entered takes a proper degree of pains to point out to him in a rational way the bearings of this work on his professional studies, and provided that the teaching staff of the laboratory is large and efficient. The latter point is obvious, but is none the less a condition difficult of fulfilment. The teaching staff makes or ruins the course. The right word of encouragement at the right time, the kindly suggestion of the proper way, the unobtrusive intimation of the significance of this or the relation of that to his other work or to science, intimate knowledge of the effort of each student, and the cultivation of a personal acquaintance with him

in the laboratory, — such points as these put vitality into the work and, more even than laboratory equipment, are the touchstones of real success. Without this element of direct personal inspiration, the best planned laboratory course will degenerate into a worse than useless mechanical routine. Even this is too plain to need the telling, were it not for the purpose of emphasizing the urgent call for what might otherwise seem a disproportionate number of instructors. Without being seriously overtaxed, one instructor cannot do efficient work with more than six or eight students at a time during four hours per day continuously through the week. And a routine so unbroken as this is highly undesirable from all points of view. Two instructors can deal properly with not more than fifteen. To have larger numbers than this in the same room, even with increased staff, means sure deterioration in the work. The majority of the instructors must be men of some years of experience, besides possessing marked teaching ability. Such points as these cannot be too strongly urged with regard to elementary laboratory instruction. Here certainly, and I believe not less in other lines of teaching, the sound principle is to give the elementary instruction to the experienced teacher, the advanced to the younger members of the staff. If we would have successful teaching of large numbers, we must face the costly and difficult task of providing for that element of direct personal relation between mature and experienced instructors and the individual student, without which impairment of the work is certain.

From this stage onward, the greater part of the work should be in the laboratories of *applied* rather than of *pure* science. True, it may be urged that, for training in scientific method and for broadening the mental horizon,

research upon subjects devoid of practical aspects may claim a real superiority, were there none other than ideal conditions involved. But we must not ignore the mental characteristics of most students in the college of applied science, — characteristics by no means to be deplored, but whose disregard means failure where their utilization may bring the highest success. Breadth of mind, and grasp of the scientific method, can be as effectually cultivated by research, rightly conducted, in applied science as in pure science; and considerations of rational stimulation of interest, and of the large amount of technical matter which cannot go untaught, turn the balance of judgment strongly against purely abstract investigation in the professional school. If results are defective, blame must be laid to practice, not to precept, — to imperfect teaching, not to erroneous theory. I am not here contending that the customary four years' course, with its large proportion of strictly professional studies, furnishes the ideal education for the engineer. The training for this line of professions may well be no less broad and therefore of no briefer duration than for the law, although of a different character. But the practical problem to be met has regard to the technical institution as now generally organized, and as it will probably long remain, as distinguished from the usual college course with subsequent professional training.

The nature of the problems to constitute the work of the technical laboratories has already been broadly indicated. In detail of method, the laboratories of different kinds and in each different institution will and should differ. Beyond the preliminary introduction to a few instruments and operations, the work must consist of the solving of technical problems of real moment by strictly scientific procedure. In every case the fact must be

brought home to the student's mind that, important as is the technical knowledge to be derived from the performance of the operation, the insight into the mode of attacking problems is of far greater value. *There is great danger that in the professional laboratory the technical will mask the scientific*, — that the practical aspect of the result of a process or investigation will overshadow the educational.

Thus the test of a dynamo-electric machine by the student will enable him to carry out a like test on other machines in his after practice. It will, moreover, give him a desirable sense of mastery of machine and measuring instruments. But if this result were the whole, the work would be but training for an artisan. If, however, the young man is made to apprehend this fact, and is, moreover, judiciously led to analyze and execute the study in a scientific manner; if he is also made to perceive that the power of grappling with matters new to him is the key to his professional success; then indeed he will have taken a forward step in his engineering education commensurate with the outlay of time.

Again and again I would insist that, whether in field, laboratory, or drafting-room, the strong central aim of technical education must be to imbue the student with the scientific method of inquiry through applying it to professional problems of real industrial interest; and that this method does not consist in merely making measurements and recording results, even if supplemented by their discussion. It is in the preliminary analysis of a new problem that scientific modes of thought and procedure are at their maximum of usefulness, and to this, therefore, the student should be most thoughtfully directed. Here I touch a weak point in most laboratory instruction, unless I misin-

terpret my own experience both as student and teacher. Whether it be in a minor experiment or in the most extended investigation, — the analysis or assay of an ore, the study of a metallurgical operation, the test of an industrial chemical process, of a steam or electric power plant, the location of a railway, the design or test of a structure, — in each of these, large or small, let the adequate preliminary scientific approach to the problem be one of the strongest features in its treatment, never forgetting that ground familiar to disgust to the instructor is still unknown land to the novice. Economy of time, effort, and materials, and therefore of expense, is in essence scientific, and must be ever conspicuous in laboratory teaching as in all branches of technical training. The opportunities for its application are abundant, and among these none is more valuable and available than that which is afforded by the use of the scientific procedure in planning in advance proper distribution of accuracy and labor, and the best balance among the component parts of an investigation. Further I must urge the vital necessity that the adequate scientific interpretation of data and results must be most stringently insisted upon. Even science, and much more technology, has a surfeit of ill-planned investigations, and of crude and undigested data, which are often worse than useless, besides involving waste of time, labor, and money. The laboratory should do its part in discouraging such crudity, and in this good office the personal influence of the instructor may be great.

We now need to consider further the limited number of higher problems which are assigned to individual students for original investigation toward the close of their undergraduate course. This class of work should assume a position of leading importance in the promotion of the

scientific spirit. It often looms before the student, it is true, in a way to give it disproportionate importance; but that fact itself renders its possibilities the greater and its judicious utilization the more imperative. No portion of the work of an institution imposes or should impose a heavier tax upon every resource, both pecuniary and educational. Its execution gives full scope for the enthusiasm and energy of the younger instructors, and taxes the vigilance of the most experienced members of the staff. For entire success the assigned problem must, first of all, be fairly simple, and, second, it must be of some genuine and preferably practical interest. Simplicity promotes more complete mastery, and this, rarely too easy, is better than the discipline however wholesome which may attend incompleteness or partial failure. The supervision of this work must be most constant and thoughtful; neither too much nor too little. It cannot be slighted without danger of worse than waste of time; for the student, even at this stage of undergraduate work, is not competent to carry out unaided a successful research. On the other hand, he must be put upon his own resources to the limit consistent with good progress. Clearly, then, in this more advanced portion of the laboratory work not less than in the earlier part, one cannot too strongly urge the need of great strength of teaching force. Without it there can be no continued success. The self-sacrifice by which a small staff carries an ever-increasing burden of such work, and carries it not badly, cannot endure without limit, and if prolonged tends to ultimate disaster.

The question of laboratory equipment demands similar consideration. Not only must the machinery, materials, and methods of the laboratory be on the commercial scale as to magnitude, — a point now too well understood to call

for argument, — but it must be "up to date." This is no less a necessity in the technical college than in the cotton mill, and for essentially the same practical reasons. But, however important and imposing may be the material equipment, the educational worth of the college rests with the men who constitute its corps of instruction. This worth shows itself through the product of the institution — its graduates — and is there judged by that part of the public whose opinion determines its future. Surely the part of wisdom lies in adequate provision for this more vital if less obtrusive factor, — the teaching staff.

To the important subject of the maintenance in the technical college of laboratories of pure science higher than the elementary ones already referred to, I can allude only briefly. The question is obviously part of the broader one as to whether courses in pure science leading to the bachelor degree should be given in these schools. So far as concerns the laboratory, the affirmative seems to me established beyond question for physics, chemistry, and biology. The influence of the association of even a limited number of men devoted to pure science upon their fellow students of technical tastes is not devoid of benefit. The greater stability and prominence of the representation thus acquired in the Faculty by the scientific departments has a most helpful effect in upholding the scientific standard in the technical courses. In turn, the reaction of the technical students and laboratories upon the students of pure science is, in my opinion, most valuable. So fully, indeed, am I convinced of the benefit of this association that a well-arranged course of pure physics or chemistry in a technical college of the highest grade seems to me the best bachelor course for a student who intends to pursue either of those sciences as a teacher or by continued study.

The relation of the laboratory to the instructor, although not an obtrusive element, is none the less a vital one in the attainment of success. As imbuing the student with the scientific method is the highest function of even the technical laboratory, so the chief duty of the instructor is the inculcation of this method. Competence for this task demands not merely a high grade of teaching ability, but also enthusiasm and some experience in scientific research. But the development of the latter qualities requires opportunity and time for the prosecution of investigation. How, then, can we hope for them to the requisite degree among instructors whose ardor is quenched and whose growth is stunted by onerous and unremitting routine duties, and who often must further tax their strength for adequate income? Whence, moreover, can the senior membership of the staff of instruction be increased or replenished with so great surety of character, attainment, and fitness as from an efficient junior membership? But how can the needful high level of efficiency be there sustained unless, in addition to securing men of sufficient technical experience, the most serious and evident effort is made by the institution to promote the intellectual expansion of its junior instructors as sedulously, if not to the same degree, as that of its students? Many of these instructors do not remain permanently upon the staff, it is true; but of those who withdraw, a large portion become teachers elsewhere, and in that capacity may render an even more effective account of benefits received than those who remain. To foster to the utmost among the laboratory staff the spirit of scientific investigation is, then, the plain duty of the school. To do this there is but one effectual way; namely, *to require original research from the instructors*, by making the annual production of a technical or scientific paper for publication, or at least a satisfac-

tory report of progress, a definite part of the duty of each of the younger members of the staff. This implies the assignment of at least one entire day per week (twice this amount would not be too much) to each instructor for this work exclusively, and consequently the increase of the staff by at least one in six; additional apparatus, rooms, and incidental outlays must also be provided for. But no more profitable investment could be made of the moderate sum thus required, and few needs are so truly urgent. The increased incentive to the best men to join the staff of instruction, and the healthful stimulus to its activity; the value of the contributions to technology and science directly resulting; the added recognition in the professional fraternity, and the community at large; the strong reaction on the vigor of the laboratory work of the students, — these are results too patent to need more than mention. Supplement a plan like this with the means of securing to the instructors the opportunity of studying important industrial works and scientific institutions by visits of inspection, and of attending and sharing in the meetings of scientific and professional societies, and can any one doubt the value of the return?

Formal requirement of investigation by members of the staff may appear unnecessary, in view of the eagerness of most of them to engage in such work; but I think that no one will recognize more clearly than they the absolute necessity of such a plan to ensure the desired result. By becoming the duty, it thereby becomes also the recognized right of the instructor; and as this privilege is for the declared best interest of the institution, the most conscientious instructor should have no reluctance in using or demanding his due share of time and opportunity.

The laboratory of the technical college must clearly be in direct relation with the technical part of the community through its investigations as well as through its graduates; and little reflection is necessary to show that in this relation lie important elements of danger as well as of benefit. The staff and methods of the laboratory must be in the closest possible touch with the best professional practice, but in all that concerns educational influence, the laboratory must lead. In that knowledge which arises from the practice of processes and the application of machines on the industrial scale and for pecuniary ends, the laboratory will continually have much to learn from the professions. In all which concerns the development of principles and scientific advance in methods, the laboratory should be the leader. But as to how far the facilities of the laboratory should be available to the community, either directly, or through the services of the staff in conducting tests, analyses, or investigations in a private capacity but with the resources of the laboratory, is a question demanding conservative, consistent, and judicious action. It pertains, however, rather to the administration than to the function of the laboratory, and may therefore be passed over with mere mention; but it leads directly to the question which sooner or later presents itself to most laboratories, as to whether a testing department, open in either a general or a restricted way to the public, is a good adjunct. Without taking space to consider the point at length, I must dismiss it with little more than a strong personal opinion in the negative. It is enough to say that if the laboratory staff and equipment are efficiently employed, neither is available for commercial testing except at infrequent and irregular intervals which will not suffice for this purpose, and which were much better employed otherwise. This assertion is not to be con-

strued into an opinion that there is not a multitude of ways in which both staff and equipment can and should be engaged upon matters of direct public concern, even though the problems be brought forward by purely industrial interests. Attrition of any professional instructor with the commercial world greatly enhances the vigor of his work; and problems relating to public welfare, safety, or even convenience, may most properly make a demand on the resources of the laboratory. The initiation of such researches, indeed, is a function to which the technical and scientific laboratory is peculiarly adapted. Such service is not only possible, but supplies precisely the sort of material and inspiration which these laboratories need for their best development, and will furnish a most effective connecting link with the community. Considerations of public duty no less than of self-interest easily make this apparent in broad cases. But the duty is not the less clear, although the tact required in the individual case may be greater, when the commercial factor enters more largely. The guiding principle is plain, however; namely, the promotion so far as practicable of scientific investigation of such industrial problems as tend toward increased industrial prosperity, for which the conditions of the laboratory afford exceptional opportunity. The industrial extension of new, purely scientific discovery is one clearly appropriate field of work. Special endowments for the extension of these branches of laboratory usefulness would be most productive, and happily are already not unknown.

It is the gratifying privilege of the friends of our Institute to know that its laboratories of chemistry (1866) and of physics (1869), organized in pursuance of President Rogers's original plan for the school, were the initial steps in

this new-world departure in educational methods, — the systematic laboratory teaching of science to classes of students. How profoundly powerful a factor this method was destined to become, we may in some degree gauge by the present great extension of the system both at home and abroad. Nor is the origination and practical initiation of the method the Institute's only contribution to it. Beyond the original laboratories of chemistry and physics, which have been greatly extended and specialized, there have been organized, in the successive administrations of Presidents Runkle and Walker, and are now, under President Crafts, in operation, laboratories of mining and metallurgy; of pure, applied, industrial, sanitary, and physical chemistry; of various branches of mechanical engineering, including steam, mill, hydraulic, and marine engineering; laboratories of "applied mechanics," for testing the strength of materials and structures; electrical and electrical engineering laboratories; a laboratory for heat measurements; and laboratories of biology, geology, and mineralogy. The analogous work in the field and designing-room has also been greatly extended. Manual training in the use of tools, organized for the greatest educational and teaching efficiency, and not with reference to the material product, was here first introduced in this country through the strenuous exertions of President Runkle in 1876. As a means of education for younger pupils, this has now, as was originally hoped, universally diffused itself over the country till its name is a household word. At the Institute it remains in the form of work in finely equipped "Mechanical Laboratories," where the proper students receive that degree of artisan training which has already been indicated as needful for the engineer.

But it is not characteristic of the Institute to rely upon

laurels won, nor to be content with mere expansion or technical progress. We may, then, be confident of the pursuance of any lines of advance which a broad outlook and wise foresight may make duly manifest. To gain this end there must be the fullest coöperation of all the elements which can contribute to it; for their most cordial interaction alone can ensure continued leadership in the noble competition for the highest educational results.

SILAS W. HOLMAN, '76.

Brookline, September 1, 1898.

THE PIERCE BUILDING

The past summer has been a busy one at the Institute, for it has seen the fulfilment of many of the hopes and plans of recent years. Vacation months, filled with the noise and confusion of building, have resulted in extension and accommodation far beyond old limits.

The rapid increase in numbers since the completion of our last building, in 1892, seriously hampered several departments by uncomfortably crowding the laboratories and drawing-rooms, and restricting the proper use of valuable books and apparatus. To-day this crowded condition is changed, at least temporarily, and with abundant room for present needs we are placing working apparatus in position, and endeavoring to make the best use of our new quarters. The Institute now has five large buildings and a new power-house, besides the shops and gymnasium well known to former students.

Work has been going on in all the principal buildings. The alterations in Rogers and Walker, the restoration of the burned buildings, now known as Engineering A and B,

and the construction of the new Pierce building and new dynamo house have made the summer days full to overflowing. To obtain the present satisfactory results the Executive Committee of the Corporation and the members of the Faculty have given careful attention to even the smallest details, and have studied to improve Institute methods in ways that years of experience have developed.

The problems to be solved were not entirely new. As long ago as May, 1896, President Walker presented to the Executive Committee plans for a new building, an extension of the former Architectural building. In the face of great obstacles the project was pushed forward and drawings and estimates prepared, although the treasury of the Institute did not appear to allow more than the satisfaction of the most pressing needs. To President Walker's great disappointment, in spite of the recent grant from the Commonwealth, these plans finally had to be abandoned on account of the impossibility of devoting certain bequests to the erection of the much needed building. From our present standpoint it can only be regarded as most fortunate that the plans then made were not immediately carried out. The receipt of the great benefactions from Mr. Pierce and Mrs. James changed the entire situation, and made it possible for President Crafts and the Corporation to study the problem of expansion with new energy.

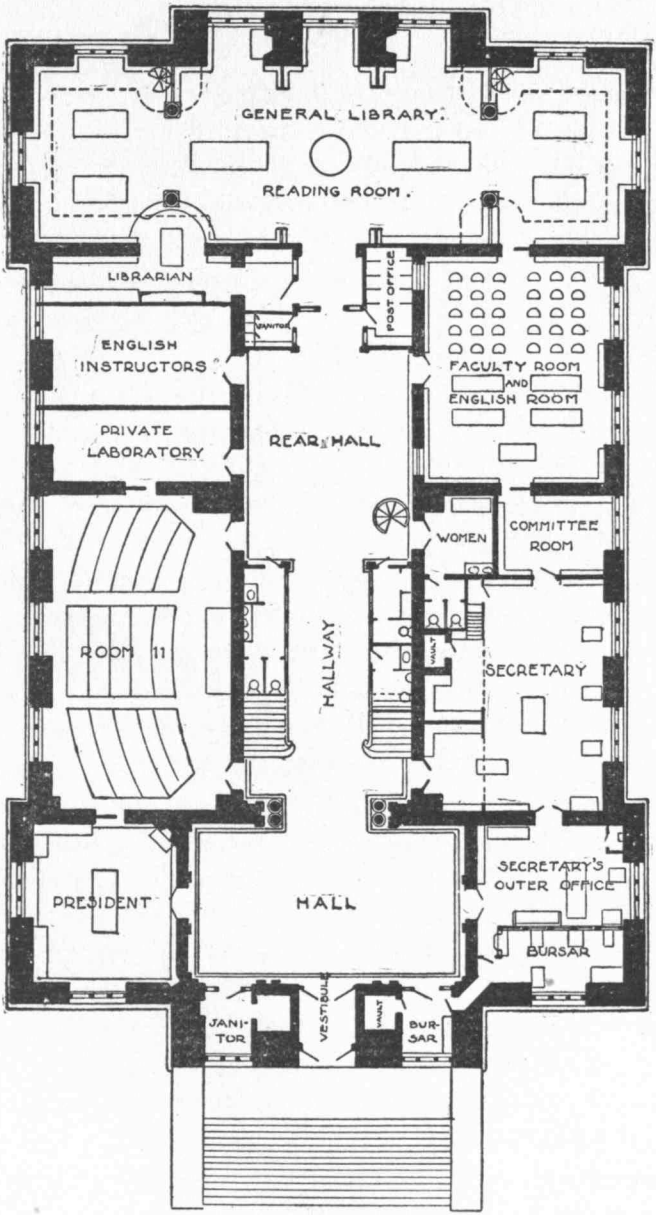
Starting with the important developments of President Walker's scheme, the proposed building was increased from five floors, each 58 feet by 148 feet, to six floors, each 58 feet by 160 feet, and, with the addition of many new features, finally developed into the present Pierce building. The principal change consisted in the adoption of fireproof construction throughout, instead of the wooden mill

Trinity Place Buildings, including Engineering A and B, Pierce Building and future extension
F. W. Chandler, Architect, 1889 and 1892. Eleazer B. Homer, Architect, 1898

construction used in our last buildings. We were, therefore, enabled to add an entire story above the limit the law now allows for buildings of the slow-burning type, and consequently to obtain greater floor area and safer quarters for valuable collections than could possibly be provided with any method of wooden construction. The removal of various departments to the Pierce building gave opportunity for expansion in all directions. At the present time familiar rooms are so changed that old students, accustomed to former cramped conditions, can hardly believe in our good fortune. But the details of the tale remain untold.

Our monumental Rogers is, and will long remain, undisturbed, as far as external appearance is concerned. Every alumnus must cherish recollections of the dignified façade that always seems to quietly tell of the sturdiness and character of Institute work and training. But from the moment one enters the swinging doors the changes are apparent, for a long vista of over one hundred and fifty feet is now obtained through the hallways. After the discussion of many plans the present interior arrangement was adopted by the Executive Committee, as the scheme best fulfilling the peculiar needs and requirements of the executive building of the Institute.

The executive offices, the rooms of the President, Secretary, and Bursar retain the same relative position near the entrance hall. Increased space for clerks for both Secretary and Bursar was required, however, and in consequence the old reading-room has been rearranged as the Secretary's office and committee-room, while a few desks are placed in the outer office. The Secretary's office is now provided with two vaults for records, and large storage space in glazed cases on floor and gallery for the multitude of books, pamphlets, and papers needed in



ALTERATIONS IN ROGER'S BUILDING

ELEAZER B. HOMER - ARCHITECT -

routine office work. The offices of the Treasurer and Bursar are entirely separated from the public office by a high oak screen, and are connected with each other by a passageway cut across the corner of the thick outer wall of the building. The removal of the "bird cage" now leaves the entrance hall unobstructed, while back of the columns the long flights of stairs to the second story have been fitted with safety treads and the lower steps widened, to facilitate the outward passage of audiences from Huntington Hall. From the rear hall descends the circular staircase leading to Professor Richards's rooms in the basement, while near this stair is the door to the room assigned for the special use of the women clerks and students. At the rear of the building the greatest changes have been made. Old students will remember the broad stairs originally leading to the basement laboratory, and the three large arches opening into the long rear room. Owing to lack of space the rear hall has lately been crowded with closets and storerooms, so that the entrance to the Biological Laboratory has been far from ornamental. All these obstructions are now cleared away, and the former dark spaces are to-day light and attractive. The removal of the departments of Biology and Geology to the new Pierce building gave opportunity for the development of Rogers along new lines, namely, the assignment of rooms for the English department on the first floor, and the planning of a large general library for the use of students and instructors both day and evening. Immediately on either side of the broad entrance to the library are small rooms for the post-office, cloak-room, and janitor's office, and beyond these are the doors leading to the room for English instructors, and to the English lecture-room, used also for Faculty meetings.

Fourth Year Architectural Drawing-Room — Pierce Building.

The new General Library is a room twenty-eight feet by ninety-eight feet, divided into three unequal spaces by Corinthian columns and ceiling beams, and surrounded on floor and gallery by mahogany bookcases shelving seven thousand volumes. Behind the columns two spiral stairs lead to the galleries that run around the ends of the room and consequently almost double the shelf capacity of the lower part. The deep alcoves opposite the entrance are provided with fireplaces that will not only help to warm the room but will certainly lend cheerful inducement to the reading of good books during the long winter evenings.

Generous accommodations for readers are afforded by the seven large reading-tables, while comfortable chairs in the alcoves and quiet corners encourage the student to linger among old and new friends. The Librarian's office is well located for control of the room, and is specially arranged for the clerical work necessitated by Doctor Bigelow's general oversight of the department libraries scattered through the various buildings. Located within easy reach of the Librarian's office and accessible to instructors and students alike is the card catalogue of all the books in the general and department libraries, while on the opposite side of the entrance the current periodicals and magazines are displayed.

For color scheme, the walls of the room have been treated in a delicate green tone, contrasting with the rich reds of the mahogany bookcases and tables, the dark green color of the numerous chairs, and the wrought iron work of electroliers and gallery fronts. The Library is lighted by electric lamps placed on ceilings and reading-tables, and the lights are so arranged that when the reading-tables are removed at time of social gatherings, the entire floor remains unobstructed. In fact, the old system of gas lighting has been abolished and electric light substituted

throughout this entire floor, with a consequent increase in safety and attractive illumination. The greater part of this electric work was fortunately completed last August, in time for the visit of the American Association for the Advancement of Science, and without doubt added much to the comfortable use of its temporary headquarters.

In addition to these changes, the withdrawal of the lunch-room to the Pierce building has allowed the entire basement to be devoted to the use of the department of Mining Engineering, where lecture-rooms have been formed to take the place of old lecture-rooms inconveniently located on the upper floors.

On the second floor of Rogers few structural changes were made. Advantage was taken, however, of the opportunity offered during the summer months to repaint the walls and renew the furnishings of Huntington Hall. In the resulting changes, notwithstanding the present harmonious appearance of the quiet green and buff tones of walls and ceilings, one may well feel a sentimental regret for the loss of the old water-colored frieze, with its quaint mythical laboratory scenes, inaccurate tools and instruments, and its always dignified, although often incorrectly drawn, outline figures. The frescoes certainly had a quiet simplicity and an appropriateness in motive that attracted all students of a technical school. Unfortunately, when placed on the walls of the hall by Mr. Paul H. Neffler, under the direction of Ware & Van Brunt, about 1870, the frescoes were executed only in water-color. Through the lapse of years a thick coating of dust gathered over the entire wall, while many of the panels were badly damaged and several entirely obliterated by water stains, due to leaks in different places. Consequently, only portions of the drawings could be restored, and these only with great difficulty, and when

all things were considered it was not thought advisable to attempt a restoration involving so much new work. It is to be hoped that the future may afford opportunity for the placing of equally interesting mural decorations of great artistic merit in the panels now left plain and incomplete.

On the second floor, also, the small central room at the front has been fitted with glass cases and closets for the housing of the Mathematical Library, up to this time hidden away in one of the upper rooms of the building. Moreover, on the third floor a room has been assigned as the long-desired students' society and trophy room, while near by in the corridor a large case will give opportunity for the display of cups and banners, the emblems of victorious contests.

With all these changes, Rogers therefore becomes the permanent centre of the executive, general, and social life of the Institute.

In the Walker building, alterations have been made to adapt the third and fourth floor rooms to the uses of the Department of Chemistry, by providing more convenient arrangements for both students and instructors. The withdrawal of the Margaret Cheney room and of the Laboratory of Industrial Chemistry allowed the throwing together of several small rooms into one large laboratory for Analytical Chemistry, with accommodations for sixty students, the rearrangement of instructors' rooms, weighing and supply rooms, and the fitting up of Professor Talbot's private laboratory and office. The fourth floor Analytical Laboratory has been partitioned off, providing a laboratory for molecular weight determinations and proximate technical analysis, accommodating twenty students, while the remaining part of the Analytical Laboratory still has places for ninety second-year men. The fourth floor Organic Lab-

oratory has been enlarged, while space not now needed in the basement has been given up to the Department of Physics.

It is perhaps needless to state that, only as the result of the erection of new buildings, giving much additional space, did it become possible to secure these changes in our older structures.

The Pierce building was well out of the ground when the disastrous fire of April 28th confirmed the wisdom of the Corporation in deciding to have the new building constructed of fire-proof material. But this change in constructive system does not appear on the exterior. In designing the present unfinished front of the Trinity Place building an attempt was made to combine the older fronts of the Engineering and Architectural buildings with the new addition in such a manner as to create a reasonable and effective exterior, that would unite the separate divisions of the interior in a harmonious façade, providing for all present needs and readily permitting future extension. This result was obtained by continuing the pier and arch system of the Architectural building to within forty feet of the southern end of the Institute lot, repeating there, in a modified form, the motive of the end of the Engineering building, and then throwing a strong uniting cornice over the whole. The constructed result is fairly satisfactory, although the end pavilion has not as yet been erected and the design is to-day incomplete.

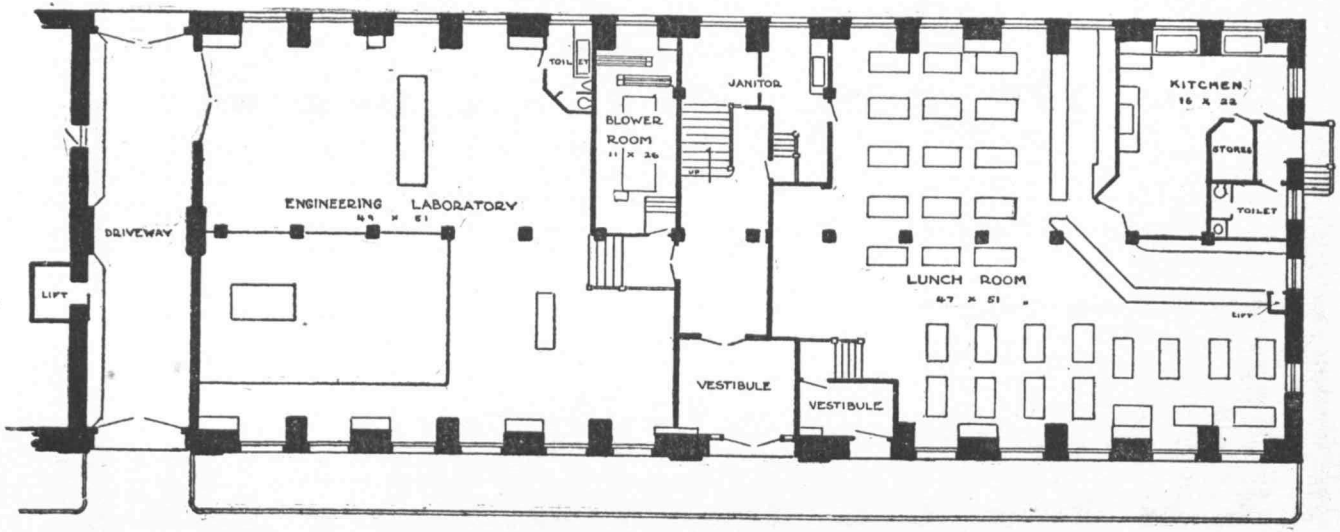
Although the building is of fire-proof construction it was not possible to adopt the modern system of steel construction for the outside walls, on account of the desirability of continuing the old exterior treatment of substantial brick piers, but, with the exception of the outer walls, steel construction is everywhere used. In general the plans show that the mill type of building has been followed, for the

reason that experience has proved it to be an economical type, one that permits a maximum well-lighted space in drawing-rooms in proportion to window area. A row of steel Z-bar columns down the centre of the building, and heavy steel beams running from columns to wall, divide the building into bays that give the keynote to the arrangement of the large and small rooms. Certain features of the other buildings found to be detrimental to their best use for technical school purposes have been avoided, while new and improved devices, that increase the practical value of the building and the comfort of its occupants, have been added.

But let us enter the building and understand the provisions made for the several departments now beginning to feel at home in their new quarters. The wide arch and vestibule lead past directory and bulletin boards, and open into the staircase hall, that, centrally located, gives direct access to all the large rooms. The staircase is constructed of steel and wrought iron, while the surrounding walls of terra-cotta rest upon the steel frame of the building. High windows on each landing admit an abundance of light, while the walls, painted in rich reds, contrast well with the grass green and dark bottle green of the iron work and the bronze color of the stamped steel fireproof doors. Altogether, the hallway forms a pleasant and attractive connective link between the different levels.

To the right of the staircase, entered by a separate outside door, is that peculiarly characteristic institution, the lunch-room, presided over by the students' good friend, Mrs. King. Here the crowding and waiting in the old narrow basement room of Rogers are entirely absent; for, with compact and up-to-date kitchen and serving arrange-

PIERCE BUILDING



BASEMENT FLOOR PLAN

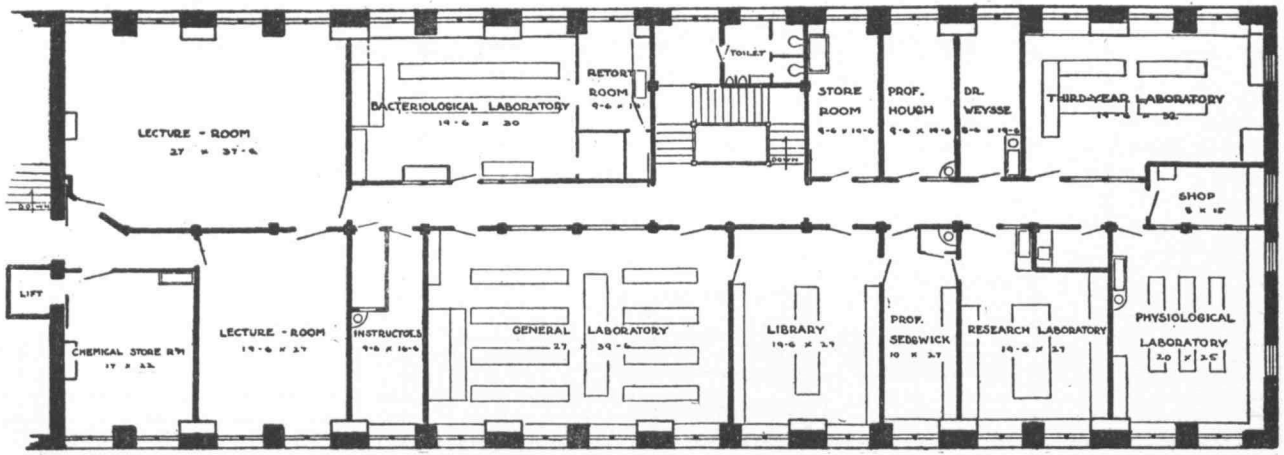
FIRE-PROOF BUILDING OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ELEAZER B. HOMER. ARCHITECT.

PIERCE BUILDING

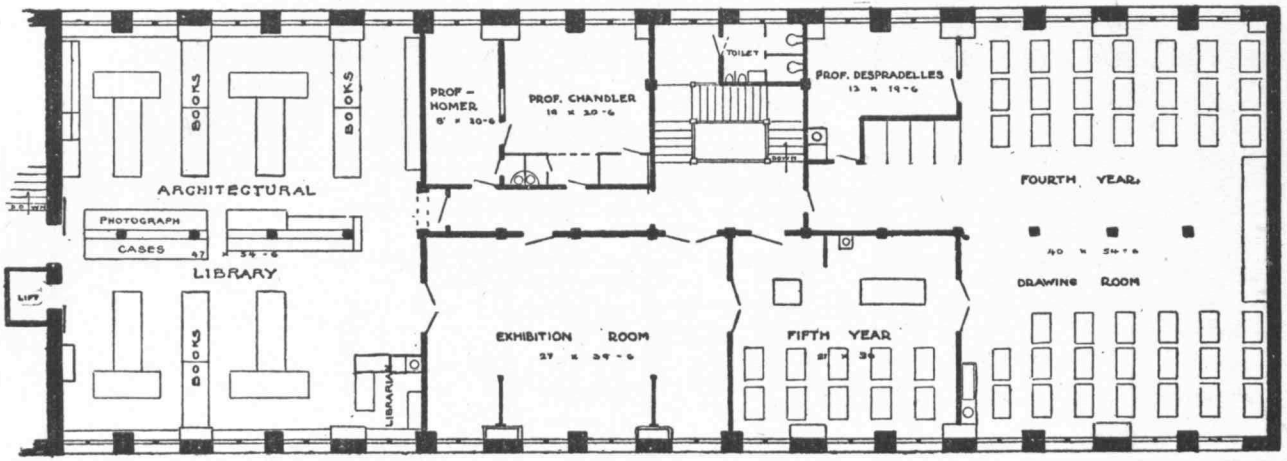
FIRST FLOOR PLAN

PIERCE BUILDING



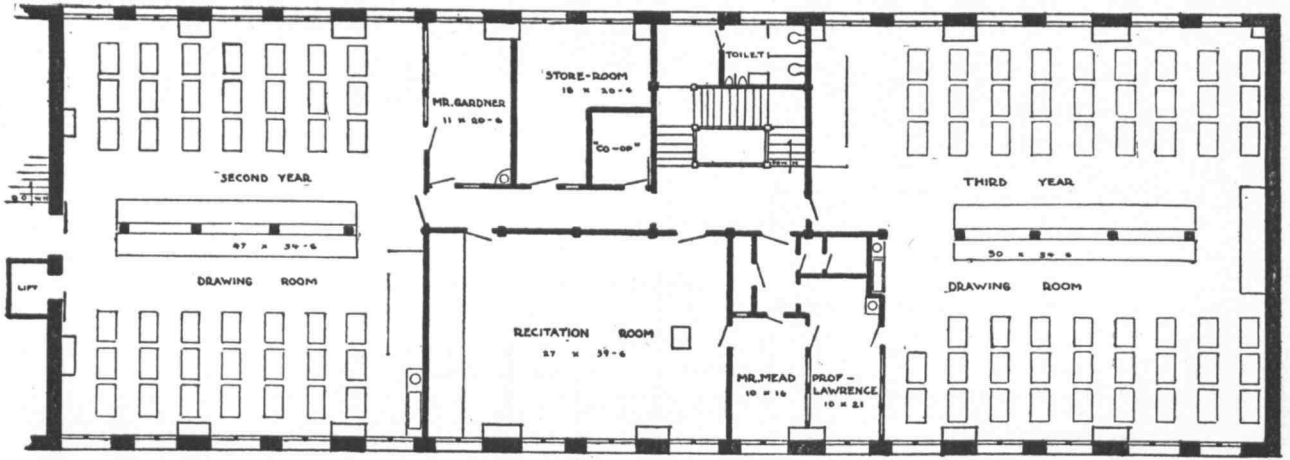
SECOND FLOOR PLAN

PIERCE BUILDING



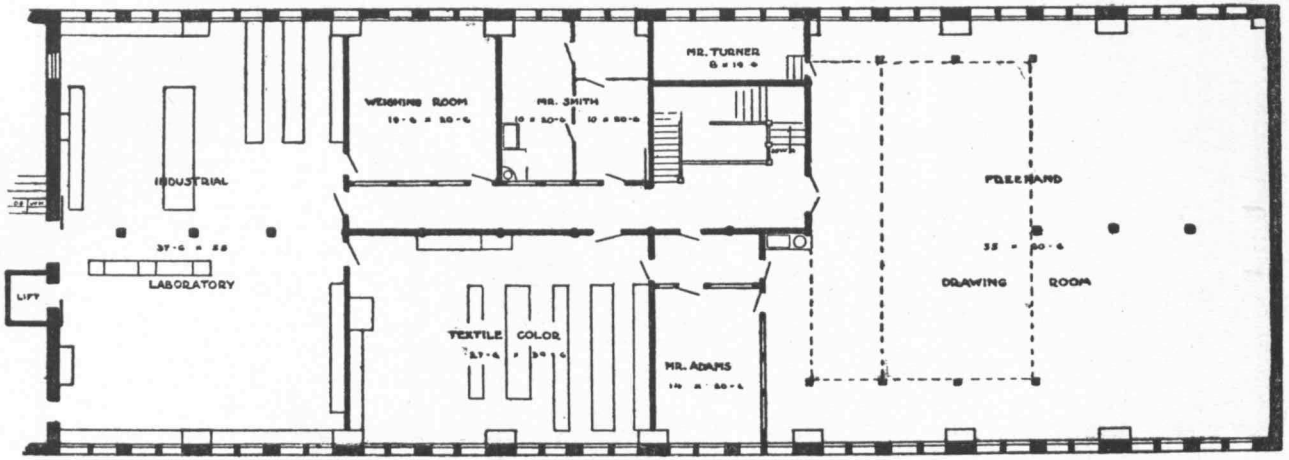
THIRD FLOOR PLAN

PIERCE BUILDING



FOURTH FLOOR PLAN.

PIERCE BUILDING



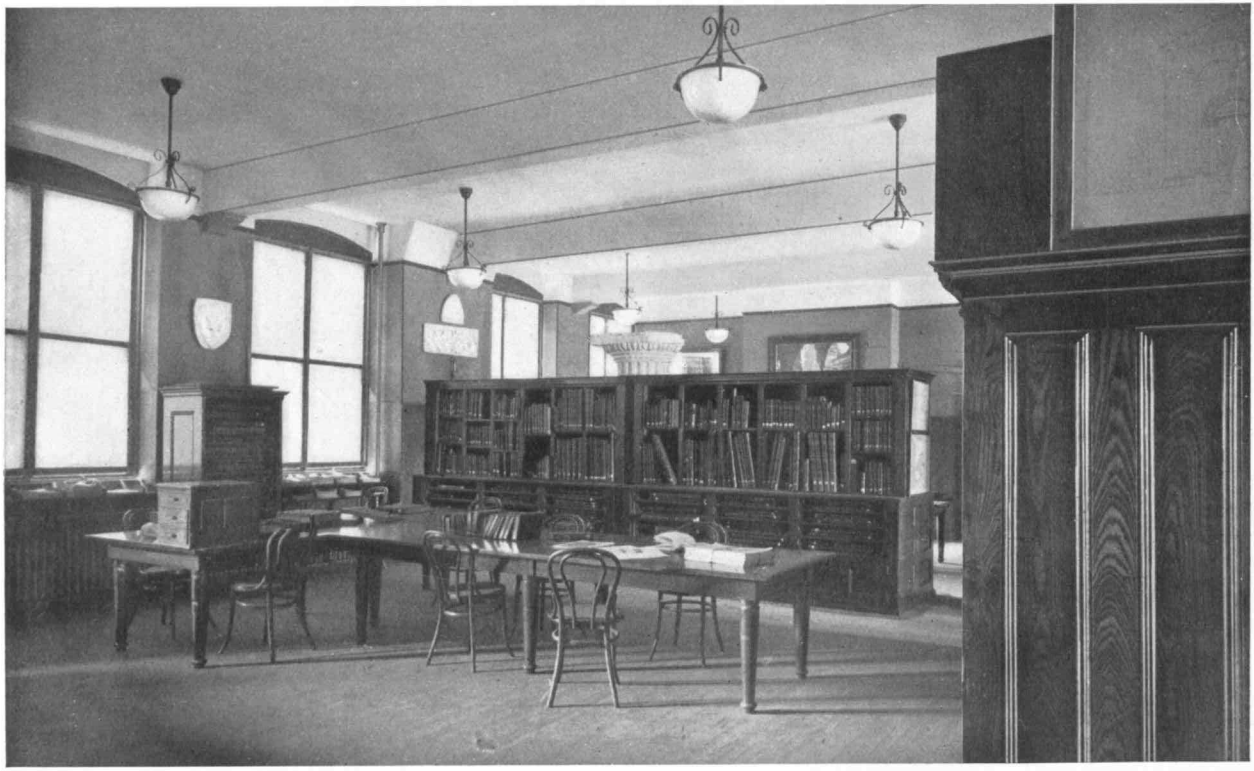
FIFTH FLOOR PLAN

ments, the five hundred students supplied daily now have spacious and roomy quarters where delay is unknown.

On the left of the staircase the new Engineering Laboratory provides space for apparatus crowded from the old buildings and for new engines to be put in place in the near future, while the good lighting and increased elbow-room help in making this a model laboratory. In this room are to be found the new compound tandem McIntosh and Seymour engine, having a maximum of 250 H. P., a new condenser capable of handling five thousand pounds of steam per hour, a new gas engine, different examples of shafting of the latest type, and examples of the use of ropes instead of belts for driving engines. Space is also provided for a ten-ton ammonia refrigerating plant. In the sub-basement a large tank, connected with the old tank in Engineering A, increases the former tank capacity to three times that of the old arrangement.

One corner of this room is cut off by the walls of the blower-room, where the air supply is partially warmed and then driven by the blower through horizontal ducts in the sub-basement to the numerous vertical stacks, where it is heated to the required temperature by large steel coils, and then rises to supply the rooms above. The vertical ducts continue through the roof and act as vents for all the rooms. Additional heating surface is also provided, as deemed necessary, by small local radiators and coils automatically controlled. In arranging the heating system Professor Woodbridge has endeavored to supply an abundance of properly warmed air throughout the building, and, by the economical use of exhaust steam, to improve on the good ventilation of the former Architectural building.

On the first floor are the rooms of the Department of Geology. Enlarged spaces have been devoted to the



A Corner of the Architectural Library — Pierce Building.

arrangement of the valuable collections of minerals and geological specimens possessed by this department, while new and improved devices have been included in the fittings of the new blowpipe-room and Professor Niles's lecture-room. All the collections are now within easy access, and the rooms are far more compact than the old rooms in Rogers.

From the staircase opens the wide door to the new Margaret Cheney room, now provided with a retiring-room and space for a small gymnasium and bath. The two recitation-rooms near by are provided with wide doors and movable chairs, so that they may be thrown open for use at times of social gatherings in the Margaret Cheney room, while a lift connecting one of the rooms with the lunch-room in the basement provides for the necessary encouragement to sociability.

The second floor is largely occupied by the Department of Biology. Not long after this department was founded, in 1883, it began to outgrow its quarters in Rogers because of the great importance Bacteriology assumed in medical and sanitary work. With the introduction of courses of study on the applications of Biology to industrial life in 1894, the original space became entirely inadequate, and the resulting use of the same rooms by classes attending lectures and laboratory exercises at the same time proved almost insufferable, and tended to promote strained relations among instructors and students. The new quarters give from two to three times the floor space formerly assigned, so that second-year students, third-year students, the departments of Comparative Anatomy, Botany, Physiology, and Bacteriology have each their own laboratories. The light in these rooms is also about ten times the strength of that in the old rooms, thus giving a perfect light for

important microscopic work. For advanced or special investigations, in sanitary and industrial applications of Biology, a special research laboratory has been set apart, which offers unequalled facilities for the working out of complex industrial problems. Professors' and instructors' rooms are also provided with suitable facilities for individual research, and altogether, for the present needs of the department, the equipment seems to be all that could be desired. The remaining space on this second floor is used for a chemical storeroom and two recitation-rooms.

The largest space in the building is assigned to the Department of Architecture, which now occupies the third and fourth floors, nearly one-half of the fifth floor, and also the upper part of the new dynamo house.

The large fourth-year drawing-room, twice the size of the old room in the former Architectural building, is found on the third floor at the south end of the building, while adjoining it is the quiet room for post-graduate students. The new exhibition-room gives ample opportunity for the display and comparison of students' work, supplying an important factor in architectural education. The new library is twice the size of the room formerly occupied, and now offers a quiet and attractive place where students can become familiar with the best books and photographs. In planning this library, an alcove system was adopted by dividing the room into several partially enclosed spaces, where students of different grades working on different subjects may find reference books and photographs within easy reach, without disturbing their neighbors in other sections. Opportunity is given, also, for the display and use of our many valuable architectural works, while the addition of the alcove devoted to painting and sculpture provides for accessories to architecture only meagrely included heretofore.

When desired, all these rooms can be thrown together, making a suite 158 feet in length, where the color scheme, changing from the light tones of the drawing-rooms to the soft green of the exhibition-room and the leather-colored walls and dark furniture of the library, emphasizes the extent and comfort of the whole. Professor Chandler's office is also on this floor and is electrically connected with rooms of all instructors of the department.

The second and third year drawing-rooms, lecture-room, storeroom and instructors' offices occupy the entire fourth floor. In all these rooms an attempt has been made to improve on the system of lighting for both day and evening work. In fact, throughout the building the upper window sashes have been fitted with special glass, that effectively diffuses the daylight through the rooms, making the central spaces far lighter than in the old buildings. After many experiments in the Physics Laboratory, the present system of electric lighting was adopted for all the new drawing-rooms. The upturned half globes with reflected ceiling light produce a soft and agreeable illumination of the entire space, and it is hoped that the new method of lighting will prove to be far less fatiguing to the eyes than the individual light system.

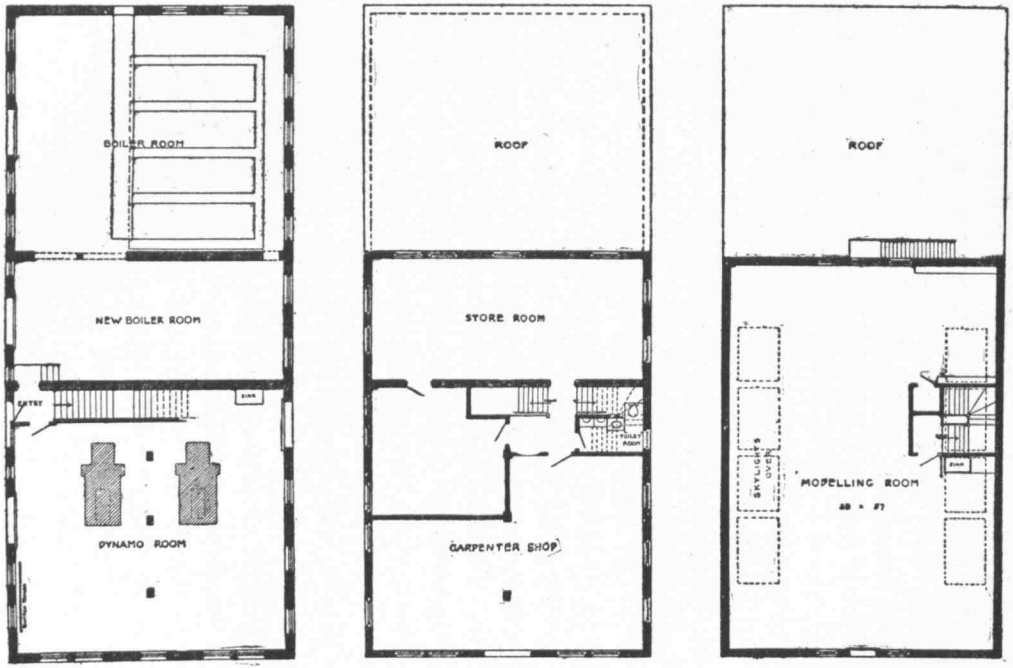
The entire space on the fifth floor south of the staircase is devoted to the architectural studio for freehand drawing, water-color and life class. One-half of this large room is beautifully lighted by low skylights in the roof, while the other half has a specially designed skylight that gives a large amount of steady north light. The light from the windows and skylights is ingeniously controlled by curtains, so that several classes can work in different parts of the room at the same time. The erection of the large north skylight was one of the most difficult structural

problems in the building, because of the unusual character of the steel and cement construction, but the results obtained fully justify the labor expended.

The remaining part of the fifth floor is occupied by the laboratories of Industrial Chemistry and Textile Coloring. These laboratories are amply furnished with top light suitable to their requirements and are fitted with many modern improvements. Specially designed sinks, desks, and hoods are fast being placed in position, and these rooms will soon be ranked among the best equipped laboratories of the Institute. The electric elevator now placed in the shaft of the old Architectural building places the Chemical Department within easy reach of the lecture-room on the first floor, and facilitates the moving of supplies from the teams that unload in the passageway on the street level.

Immediately back of the large buildings a new Dynamo House has been built capable of holding four large engines and dynamos. At present only two Westinghouse direct current multipolar generators are required for supplying all lights and power in the surrounding buildings. Two new boilers have also been added, still leaving abundant space for two additional boilers when needed. Over the dynamo-room a new carpenter shop is to be fitted with electric lathes, saws, and planes for the use of the Institute workmen, while on the third floor the entire space is left open and unobstructed, and is to be used by the architectural classes in modelling.

The restoration of the upper stories of the burned buildings has also been completed and a few changes have been made in the shape and use of old rooms. In Engineering B, the Laboratory of Applied Mechanics is now extended into the basement, the second floor occupied as a drawing-



FIRST FLOOR PLAN

SECOND FLOOR PLAN

THIRD FLOOR PLAN

DYNAMO HOUSE - MASS. INSTITUTE OF TECHNOLOGY

ELEAZER B. HOMER - ARCHITECT -

room for classes in Mechanical Engineering, the third floor devoted to the expanding needs of the Department of Naval Architecture, and the fourth and fifth floors used by the Civil Engineering drawing classes. A consequent expansion has taken place in Engineering A, the most notable changes being the increase in size of the Engineering Library, new rooms for professors and instructors, and the assignment of space for a model and specimen room for the Civil Engineering Department.

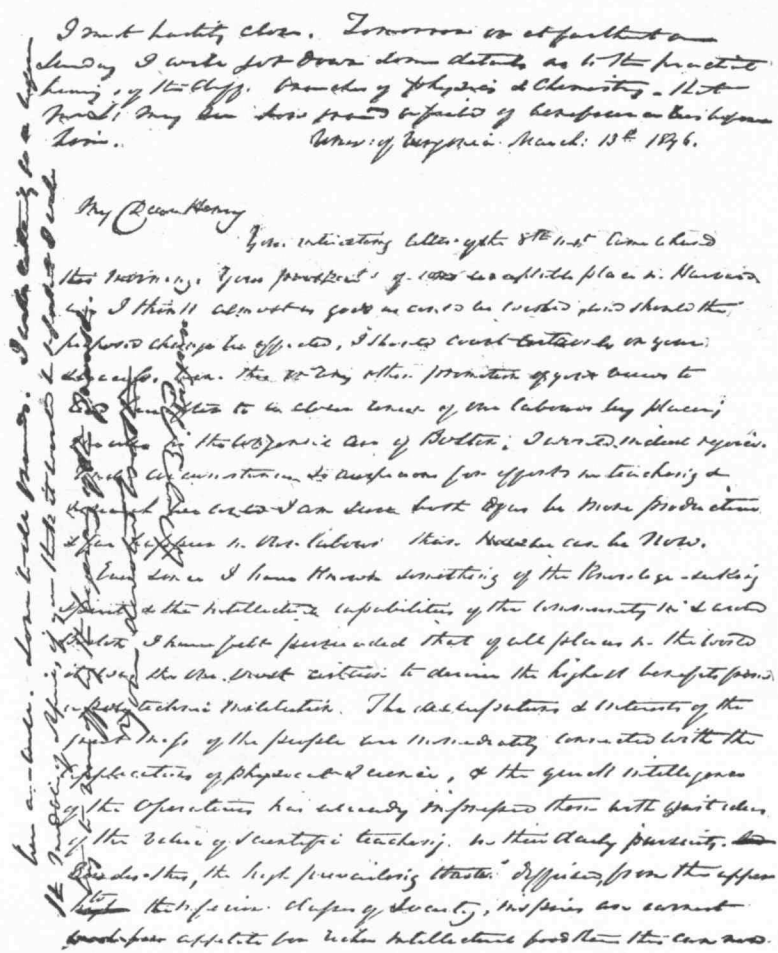
To accomplish these results tons of stone, brick, steel, and cement, and months of busy labor, have been required. The constructive problems, however, cannot here be described, although they form the backbone of the work accomplished. Pile foundations, Z-bar columns, plate girders, concrete floors, and difficult plumbing, lighting, and heating arrangements belong within the province of the architect's office and builder's workshop. Although absolutely essential to the right use and life of the building concerned, these important details remain concealed and overlooked in the completed structure.

When solving these involved problems of design and construction we trusted that in due time the silver lining would appear in our clouds of dust and labor. Now, thanks to the generous benefactions of good friends and the broad policy of our Institute officers, we are beginning to appreciate the benefits and increased comforts the summer's efforts have brought, and instructors and students take up each day's work with renewed energy and encouragement.

ELEAZER B. HOMER, '85.

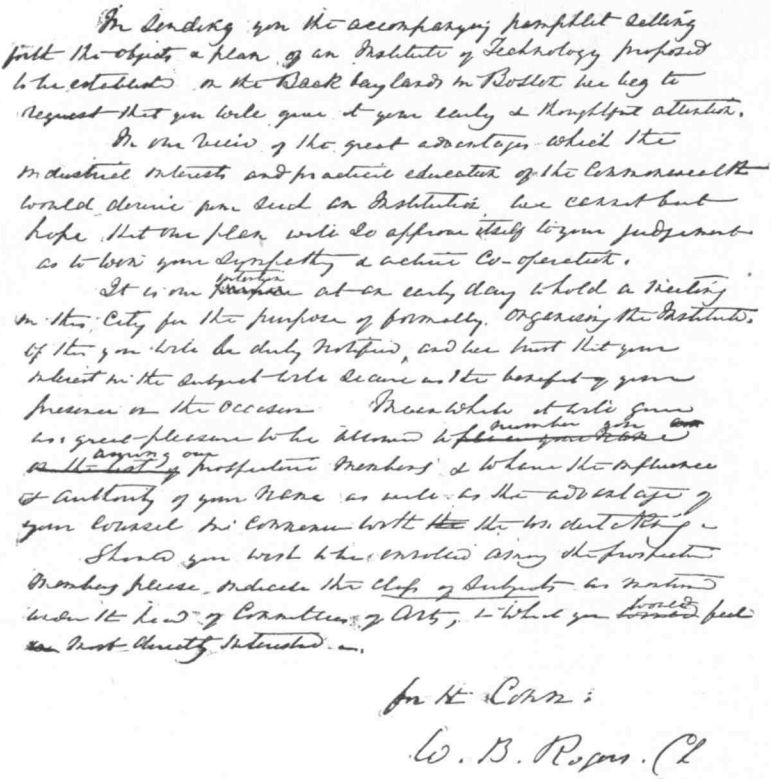
REPRINTS

It is proposed to publish in THE REVIEW from time to time transcripts or fac-similes of early documents relating to the Massachusetts Institute of Technology. Most of these are now in the possession of Mrs. William Barton



Rogers, but they will eventually become, through her generosity, the property of the Institute.

Meanwhile, her cordial interest and that of the Institute authorities enable THE REVIEW to reproduce such of these papers as are of general interest. Although, with one excep-



tion, not yet forty years old, they possess already a flavor of antiquity, so crowded with achievement have been the few years of the Institute's existence, so rapid have been the changes in collegiate methods and ideals, and so great has been the growth of the city of Boston.

The immediate origin of the Institute may be traced,

MASS. INSTITUTE OF TECHNOLOGY.

The closing examinations for the present term of the Institute's School of Industrial Science will take place in Room No. 3, Mercantile Building, Summer street, in the following order, viz:—In French, on MONDAY, the 19th inst, from 3 to 5 o'clock P. M.; in Physics, on TUESDAY, the 20th inst., from 9 to 12 o'clock A. M.; in Geometry and Trigonometry, on WEDNESDAY, the 21st inst., from 9 to 12 o'clock A. M.; in Chemistry, on THURSDAY, the 22d inst., from 9 to 12 o'clock A. M.; in Algebra, on FRIDAY, the 23d inst., from 9 to 12 o'clock A. M.

The members of the Institute and others interested are respectfully invited to be present.

June 19—3t WILLIAM B. ROGERS, President

Mass. Institute of Technology.

SCHOOL OF INDUSTRIAL SCIENCE.

THE regular courses of this Institution will be opened on MONDAY, Oct. 2, and be continued without interruption through a period of eight months. Applicants for admission into the first year's course should be familiar with the subjects usually taught in our English schools, including expertness in the leading rules and processes of Arithmetic and a ready use of the pen. They should, moreover, be familiar with the elementary operations of Algebra, and have a clear knowledge of the earlier theorems of plane Geometry.

There will be no formal or extended examination, and no classification of candidates prior to admission into the FIRST year's course, but all such students will be required to pursue their studies in common, until the *first stated examination* (in November), after which they will be classified into an upper and a lower section, according to the preparation and aptitude shown by them in this and in their daily examinations.

Candidates for admission into the SECOND year's course will be expected to be familiar with Algebra so far as treated in the ordinary text books, excepting the general theory of equations, and with Geometry and Plain Trigonometry in general, as well as the application of the latter to the simpler class of problems. They must also be acquainted with the elements of Physics and Chemistry, and have made some progress in Free and Geometrical Drawing and in the rendering of French into English prose.

Students who, from unequal preparation in different departments, could not profitably enter all the classes of the second year will be allowed, after due examination, to enter partly on the first and partly on the second year's course, and they, as well as all other students, may in the progress of the session be advanced to a higher or remitted to a lower class of studies, according to the results of the daily and stated examinations.

Students not intending to take an entire course may enter any one or more of the scientific departments on giving suitable evidence of preparation for the same.

The fee for the entire course, either of the first or of the second year, will be one hundred dollars, payable one-half at the time of matriculating, and the other during the first week of February following.

Students desirous of entering the school are requested to call at the office of the Institute, No. 1 Mercantile Building, 1 Summer street, Boston, between 11 A. M. and 1 P. M. on or after Sept. 20, for conference with one or more of the Professors.

A detailed programme of the organization, and the regular courses of the school for the whole four years, as well as of the evening courses, will soon be ready for distribution.

WILLIAM B. ROGERS,
Pres. Mass. Inst. Tech.

Institute's Rooms, Sept. 1, 1865.

perhaps, to a plan drawn up jointly by William B. Rogers and his brother, Henry D. Rogers, for submission to John A. Lowell, Esq., the first trustee of the Lowell Institute. This plan, presented in April, 1846, contemplated the establishment, as a part of that magnificent trust, of a school of applied science, or technology. The Lowell Fund, in the opinion of its trustee, was not available for such use; but in 1847 were established, for the very purposes outlined by the brothers Rogers, the Lawrence Scientific School at Harvard University and the Science Department (afterwards the Sheffield Scientific School) at Yale University.

Fourteen years elapsed before the incorporation of the Massachusetts Institute of Technology; but in the close relations of this college to the Lowell Institute, in its indebtedness to the generosity and untiring devotion of the present trustee of this great fund, in its supervision of the Lowell Free Courses of Instruction and the Lowell Free School of Design, the proposition of the distinguished brothers has been most happily, though indirectly, realized.

In view of the interest attaching to so early a formulation of the idea of an Institute of Technology, The Review reproduces in fac-simile the first page of a letter written on March 13, 1846, by Professor Rogers (then at the University of Virginia) to his brother Henry. The letter itself sets forth at great length the general plan of a school of applied science, and may be found in the first volume (pp. 259 and 420) of the "Life and Letters of William Barton Rogers." The page here reproduced is of special interest because of its reference to Boston as an ideal place in which to establish such a school as the brothers Rogers at that time proposed and as William Rogers afterwards actually founded.

The second fac-simile is of President Rogers's draft of a

SCHOOL OF INDUSTRIAL SCIENCE,

OF THE

MASS. INSTITUTE OF TECHNOLOGY.

In anticipation of the permanent organization of the School, and in order to facilitate the progress of students who may wish to qualify themselves more completely for the regular course, as well as to save the time of such as may wish to enter in advance the second year's studies, it is proposed to open, on MONDAY, the 20th of February, in the rooms of the Institute, 16 Summer street, classes in the following subjects:

Mathematics, with practice in Geometrical Drawing, and Shading in India Ink; Lessons in Descriptive Geometry, illustrated by a suite of models in relief.

Physics, including elementary doctrine of Forces, and Mechanical Properties of Solids and Fluids, accompanied by Manipulations.

Chemistry of the Inorganic Elements, with Manipulations.

Practice in the use of the Plane Table, Level and Geodesic Circle.

Free Hand Sketching.

The French Language.

This preliminary course will cover a period of four months. Persons proposing to enter at this time should make known their intention as soon as possible. Information as to cost, conditions of entrance and other particulars, can be obtained by applying at the rooms of the Institute between the hours of 11 and 1, or by addressing the undersigned at the same place.

WILLIAM B. ROGERS,
Pres. Mass. Inst. Tech.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

School of Industrial Science.

The department of professional instruction to be opened on October 2d, is intended,

First, for such students as by a full course of scientific studies and practical exercises, seek to qualify themselves for the professions of the Mechanical Engineer, the Civil Engineer, the Engineer of Mines, the Builder and Architect, the Practical Chemist and Metallurgist, and the Teacher of Applied Science; and

Second, for those who aim to secure a training in some one or more of the special branches included under either of these heads.

The degrees corresponding to the leading divisions of the school will be as follows:

The Degree of Mechanical Engineer.
" Civil and Topographical Engineer.
" Geologist and Mining Engineer.
" Practical Chemist and Metallurgist.
" Builder and Architect.
" Bachelor of Science.

Besides the above degrees, embracing the several complete courses of study, certificates of attainment will be given for proficiency in special branches, such as Chemical Analysis, Mining and Metallurgy, Machine and Architectural Drawing, Navigation and Nautical Astronomy, &c.

The Laboratories in the new building will be in readiness soon after the opening of the Courses, and every facility will be afforded the students in Analytical Chemistry, Assaying, Metallurgy and Practical Mineralogy. They will be familiarized with the typical minerals, rocks and fossils, by the use of a suite of "hand-specimens," and will also have the privilege of studying the large and conveniently contiguous collections of the Boston Society of Natural History.

For details, application may be made at No. 1, Mercantile Building, 16 Summer street, between the hours of 11 A. M. and 1 P. M.

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circular letter sent in 1862 to prominent men, asking their aid and countenance for the Massachusetts Institute of Technology, already founded, but existing as yet only in name.

The remaining fac-similes are of advertisements which appeared in the public prints during 1865 and 1866, announcing the preliminary and first regular sessions of the "School" of the Massachusetts Institute of Technology.

EDWARD AUSTIN

Our friends are rejoicing with us over the generous gift of the late Edward Austin, of this city. His will, filed in the Suffolk probate office, November 23, 1898, provides for public bequests of more than one million dollars, four hundred thousand dollars coming to the Massachusetts Institute of Technology.

The sections of public interest read as follows:

Fifth — I give to "New England Trust Company of Boston" $100,000, the interest upon which they will pay to needy aged men and women who had been in better circumstances in early life but who had become in want when in old age.

Sixth — I give to "Harvard College," Cambridge, $500,000, the interest upon which they will pay to needy meritorious students and teachers to assist them in payment of their studies.

To the "Massachusetts Institute of Technology" I give $400,000, four hundred thousand dollars, the interest to be applied as that of my bequest to Harvard College.

To "Radcliffe College" (women's college) I give $30,000, thirty thousand dollars, the interest to be in the same as that to Harvard College.

To "Roanoke College" (Julius D. Dreher, president) I give $30,000, thirty thousand dollars, on same terms as that to Harvard College.

To "Tuskegee Normal and Industrial School" (Booker T. Washington)

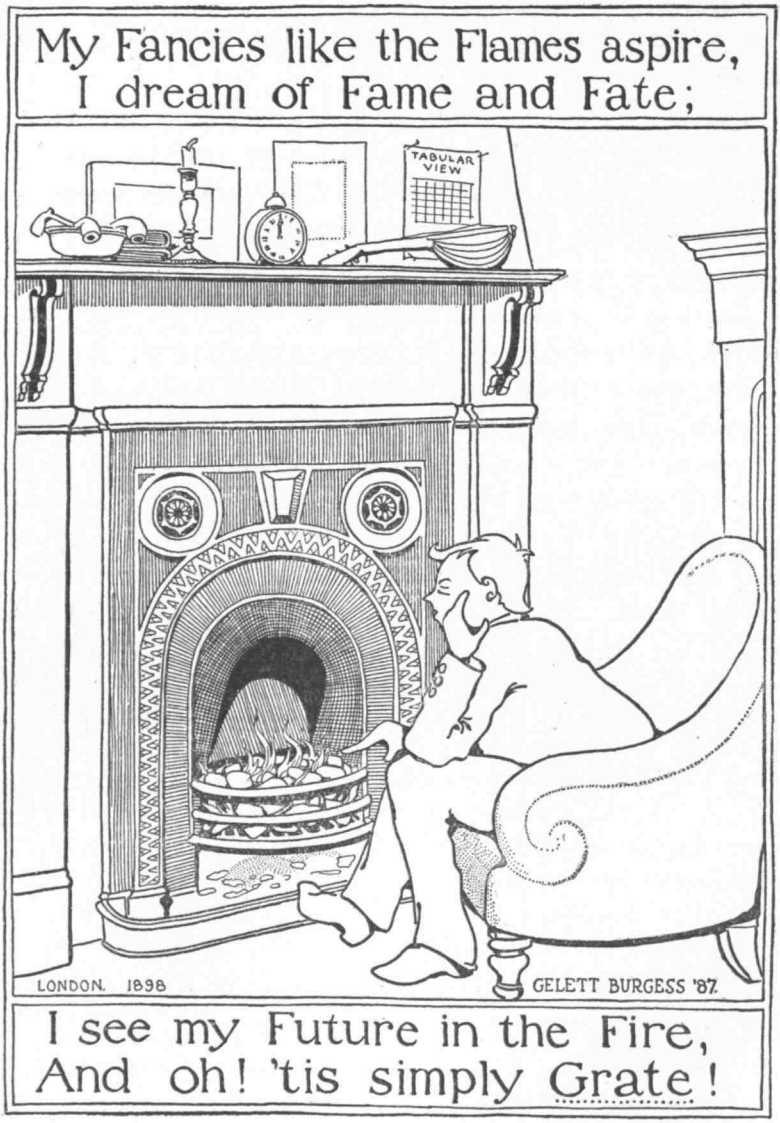
I give $30,000, thirty thousand dollars, on same terms as that to Harvard College.

I give to "Bacteriological Laboratory" (Harvard Medical School) $10,000, ten thousand dollars.

Mr. Austin was one of the class of "East India Merchants" so prosperous in the first half of this century. Born in Portsmouth in 1803, his childhood was spent in Boston, and his permanent home and interests have been ever here in spite of years of absence in the far East.

In 1859 he retired with a comfortable fortune, which has increased with forty years of fortunate investment.

He was a friend of President Rogers and must frequently have heard his enthusiastic exposition of the Institute. The first microscope owned by the Department of Biology was his gift. It may be assumed that this gift comes to us from a general appreciation of our needs and worth rather than from interest in any particular line of our work. If applied as are our present scholarship funds the bequest will provide eighty full scholarships, nearly doubling our present supply and enabling us to give timely assistance to deserving students who would otherwise be unable to remain.


My Fancies like the Flames aspire,
I dream of Fame and Fate;
TABULAR VIEW
LONDON. 1898
GELETT BURGESS '87.
I see my Future in the Fire,
And oh! 'tis simply Grate!

Reverie

GENERAL INSTITUTE NEWS

CHANGES IN BUILDINGS

THE most notable changes at the Institute this year are due to the erection of the Pierce Building, of which an account will be found on another page. This expansion has reacted on all departments of the Institute, and not least on the administrative. Eighteen years ago, to go back to very ancient history, the entire administrative work of the Institute was conducted in the small corner room, twenty-four feet square, now known as the secretary's outer office. The president had a small enclosure in one corner, the bursar another, and the remainder sufficed for the secretary, who was also the head of a department, and for a single assistant. With the erection of the Walker Building, it proved practicable to give the president his present room, which had previously been the general library. Nine years ago the bursar and the secretary, with their assistants, were still crowded into the original 576 square feet. How it was possible to conduct their various official functions in the eddies of a stream of expressmen, letter-carriers, and students, no one now connected with the administrative service is quite able to understand.

The present situation, while beyond comparison with that of the earlier time, does not suggest any large excess of room. The secretary's inner office of 1890–98 has been expanded by the addition of the entire general library room except for two small portions, one of which meets the urgent need of a private office and committee-room. The large room accommodates liberally the general business and clerical work, and is at the same time guarded against undue confusion by the preliminary sifting outside. Abundant wall cases, a wide gallery, and a two-story vault serve for storage. It is for the first time possible for committee meetings to be held and visitors to be received with a degree of comfort and order. It is for the first time possible to have the innumerable publications of the Institute kept within easy access, instead of in the

heterogeneous disorder of the janitor's dark storeroom. Predictions are notoriously unsafe in such a connection, but it may be reasonably anticipated that the present arrangements, if not definitive, will prove adequate for a considerable series of years. The bursar has been enabled, in connection with the transfer of the post-office and coat-room to the rear of the hall, to secure additional space at the front of the building, without appropriating a larger share of the general office.

Passing to the rear of the Rogers Hall, one comes to the new General Library, with an entrance and interior of which the dignified architectural effect is fully in keeping with the façade and the front hall of the Rogers Building. To one familiar with the labyrinthine mazes of the former biological laboratory, the change could not be more impressive. For the first time a general library of ample proportions and convenient situation is opened for the use of students. For the first time an Institute student has an attractive place in our buildings where he can study during the late afternoon and evening. The shelves are occupied in part by the English literature library, brought down from the Course IX. reading-room. There is still ample space for considerable accessions in this direction, and it is hoped that they will not be long in coming. Adjoining the general library, Professor Crosby's former room has been trisected, one division serving as an office for the librarian and his assistant, another for consultation purposes of the instructors in English.

The eastern room, formerly occupied by Professor Niles, is the new headquarters of the department of English. Adjoining the secretary's private office, it serves also as a convenient place for Faculty meetings. The proximity of the department of English to the general library should bring literature closer to a larger number of Institute students than has ever before been possible.

CHANGES IN THE INSTRUCTING STAFF

To the great regret of the officers and students of the Institute, Captain Bigelow was obliged in the spring to terminate his service

as professor of military science and tactics by order of the government that he rejoin his regiment, the Tenth U. S. Cavalry, for active service. Captain Bigelow came to the Institute in the fall of 1894 from a remote Western post. He came with the training, not only of a soldier, but of a scholar, and with the needful appreciation of what could be expected, and what could not, in the military instruction of our students. It proved somewhat perplexing to condense seventeen hours of military tabular view into four, but this was accomplished, and there followed during the four years a steady advance in the character of the military course and in the interest of the students taking it. This was accompanied, also, by a much better regulation of questions of excuse. During previous years it had been so easy to satisfy certain physicians of a first year student's inability to perform simple military drill, that it seemed hardly possible for so many weaklings to survive the strain of a four years' course. Some of them escaped early decease only by active participation in football and other mild gymnastic exercises. Shortly before Captain Bigelow came to the Institute it had been decided by the Faculty that, on the one hand, all applications for excuse should be closely scrutinized, and that, on the other, students excused for physical disability should be required to take, in place of the drill, a theoretical course not less exacting. The effect of this change has been to reduce the number of the lame and the halt by about seventy-five per cent.

For his classes at the Institute Captain Bigelow prepared extended notes, which have been printed by the Institute, and will prove of permanent value. His relations with his colleagues have been as pleasant as possible, and were appropriately terminated by an enjoyable Faculty dinner at the Technology Club. How honorably Captain Bigelow distinguished himself in the brief war with Spain is not so well known as it ought to be, glory and service having been "independent variables" in the Santiago campaign. His friends are glad to know that he has fully recovered from his four wounds, and that he is now in camp with his regiment at Huntsville, Ala., with the pleasing alternative of a more or less early return to Cuba.

The War Department having declined to make details of active officers for college service for the present, the military instruction for the current year has been placed in the hands of Capt. John Bordman, Jr., M. V. M.

Dr. H. P. Talbot, '85, and Dr. H. O. Hofman have been appointed professors of analytical chemistry and metallurgy, respectively. Dr. Talbot graduated in the chemical department in 1885, and has been connected with the Institute continuously since that time except for the two years of his study in Germany. His work in the chemical department has been mainly the conduct of the large classes in analytical chemistry. While Professor Drown was still at the head of the department, Dr. Talbot shared this work with him, and assumed also difficult and important cares in the management of department affairs.

Professor Hofman graduated at the Royal Prussian School of Mines, both as mining engineer and as metallurgist, in 1877, entering the government service as chemist and assistant at the Lautenthal Smelting Works, in the Harz Mountains. He came to America in 1881, and engaged in metallurgical work, being employed in Pennsylvania, Missouri, Kansas, Colorado, and in Mexico. In 1885 he became private assistant to Professor Richards, and in 1886–87 delivered a course of lectures to our students. In the autumn of 1887 he was appointed professor of metallurgy in the School of Mines in Dakota, where he remained until recalled to the Institute as assistant professor of mining and metallurgy. He was appointed associate professor in 1891.

Assistant Professor D. P. Bartlett, '86, has been appointed associate professor of mathematics, having served the Institute with marked success, not only as a teacher of mathematics, but in other directions, since his graduation.

Mr. H. G. Pearson, A. B. (Harvard), instructor in English since 1893, has been appointed assistant professor. The department of English has been so much strengthened in recent years that it is now able to coöperate effectively in criticism of written work of students in other departments.

Mr. James Swan, '91, after spending the summer vacation in

government service at Newport News, finally resigned his instructorship in naval architecture to enter the employ of the Newport News Shipbuilding Company. Mr. Swan's work in the department was taken by Mr. Carl H. Clark, '95, who was transferred from the department of mechanical engineering.

The following assistants have terminated their connection with the Institute: Frederic W. Howe, George K. Burgess, '96, Leonard H. Goodhue, '96, Fred E. Busby, '97, Minor S. Jameson, '96, William L. Root, '91, Charles N. Haskins, '97, Nathan Hayward, '97, Herman W. Marshall, '97, Minot A. Bridgham, Ira G. Studley, and William F. Hyde.

The following new assistants have been appointed: Charles B. Breed, '97, in civil engineering; Joseph G. Coffin, '98, in physics; William T. Hall, '95, in analytical chemistry; George M. Holman, M. D., in biology; Areli H. Jacoby, '98, in industrial chemistry; Carleton S. Koch, '98, in mining engineering; Alice G. Loring, in architecture; Joseph C. Riley, '98, in mechanical engineering; Eugene W. Rutherford, '98, in mechanical engineering; Lewis J. Seidensticker, '98, in oil and gas analysis; Harrison W. Smith, '97, in physics; Maurice De K. Thompson, Jr., '98, in physics.

CORPORATION NOTES

The annual meeting of the corporation was held Wednesday, October 12th. Dr. Francis H. Williams, '68, was reëlected secretary and member of the executive committee for five years.

The usual standing committees were appointed, Mr. Howard A. Carson, '69, succeeding the late Mr. Lincoln as a member of the committee on nominations, and Mr. Choate taking Mr. Carson's place in the committee on the department of mathematics. Three new members were elected: Mr. Eben S. Draper, of the Draper Manufacturing Company, Hopedale, Mass., Mr. Robert S. Peabody, of Peabody & Stearns, and Mr. Elihu Thomson, of the General Electric Company, Lynn.

Meetings of the executive committee have been held September

27th, October 18th, and November 1st. The purchase of additional apparatus for the gymnasium has been authorized, with an appropriation of $133.50.

The president was authorized to make any needful arrangements for representation of the Institute at the twelfth annual convention of the Association of Agricultural Colleges and Experiment Stations at Washington, and has himself attended the convention.

During the past year the corporation has lost one of its oldest members, Hon. Frederic W. Lincoln. Mr. Lincoln's name appears in the original charter, and his active connection with the Institute included service on the following committees of the corporation: Museum; Society of Arts; School of Industrial Science; Language, Literature, and History; Nominations; Museum of Fine Arts. As long as his health permitted, he was a frequent and interested visitor.

FACULTY NOTES

First Year Mathematics. — Solid geometry, having been made an absolute entrance requirement, drops out of the first year schedule. All regular students are now expected to complete algebra and plane trigonometry in their first term; and in the second term the time previously assigned to trigonometry will in most cases be devoted to an elementary course in the theory of equations, but in Courses I. and XI. to spherical trigonometry, which has heretofore occupied a portion of the calculus time of the second year.

Architectural Engineering. — To meet the requirements of modern high building construction a new option has been introduced in Course IV.

This option begins with the second term of the third year. In place of academic design and some of the purely artistic courses, others have been substituted leading to the study of architectural engineering. Lectures and problems on the principles of applied mechanics, and lectures in the theory of structures, including loads and reactions, shears and moments, proportioning of beams, col-

umns, and tension pieces, the computation of plate and box girders, wooden and steel roof trusses, steel framing, wind bracing, fireproofing, foundations, arches, etc., give the student the necessary preparation for practical problems in structural design which will form the important feature of the course. In the fourth year some time is given to laboratory tests on the strength of building materials.

The course as arranged at present is for undergraduates, but it is hoped that graduate students who have completed the regular course in architecture will find in the engineering option an attractive field for work.

Course for Naval Constructors. — Much interest was taken by the Institute and its friends in the plan of the Navy Department to send naval graduates here for graduate instruction in naval architecture. Although the plan was ultimately abandoned, the recognition shown the high quality of the Institute's work in general, as well as in its department of naval architecture, was not less gratifying.

Registration. — The total number of students in the catalogue now in press is 1,171, a falling off of twenty-seven from last year. This marks the close of a period of nineteen years of uninterrupted growth, during which our numbers have increased from 188 (1878–79) to 1,198 (1897–98). Wonderful as this growth has been, it has involved heavy cares and great sacrifices. Funds urgently needed for other purposes have been over and over again absorbed in the purchase of costly land and the erection of buildings for which architectural effect must be sacrificed to secure the greatest floor space. President Walker's strength and optimism were many a time strained almost to the limit even of his elasticity, to make provision in some sort for ever increasing numbers, — which he would on no account have wished to check.

Since 1893 the tide has slackened. It has no longer been necessary to have more sections and more rooms every year, — as the boy whose clothes fit him but for a month. We may fairly believe that at thirty-three we have reached maturity. Our strength

and usefulness should continually increase, even if we never have many more students than now. That there will be any greater falling off than may result from the contingencies of temporary business conditions need scarcely be feared, so long as the Institute maintains its high standards, and the alumni exemplify the value of its training.

It may be noted that the number of women students has decreased by exactly the same difference, twenty-seven, with the total number of students, so that the number of men is identical with that of last year. The explanation of this curious circumstance is not far to seek. Last year there were thirty women registered as special students in biology. This year there are but nine, the difference being undoubtedly due to the delay in the completion of the Pierce Building, and the impracticability of beginning biological laboratory work until some time after the opening of the term. It may be noted, further, that the number of regular students is but three smaller than last year, and that the aggregate number of regular students below the fourth year is twenty-one larger. These considerations appear to make it probable that the number of students next year will be considerably larger.

Graduate Scholarships. — Graduate scholarships are held by D. W. Edgerly, '98, W. T. Keough, '88, E. S. Manson, Jr., '97, G. P. Stevens, '98, C.-E. A. Winslow, '98. The names of graduate scholars will be given this year in a separate list in the catalogue.

Fellowships. — After consideration by a committee, it has been decided by the Faculty to transfer the care of fellowships to the standing committee on advanced degrees. This year for the first time the Faculty has made a fellowship appointment not carrying any pecuniary award, the only available fellowships having been already assigned. The incumbent of this honorary fellowship is Mr. H. W. Chamberlain, '95, and the action of the Faculty signifies recognition of the importance and interest of his plans for study abroad. It is hoped that cases of this kind will become more frequent in future.

Dr. George V. Wendell, '92, having held a fellowship during

two years of foreign study, did not renew his application. In recognition of his scholarly standing, his name is retained as that of an honorary fellow.

THE UNDERGRADUATES

[In all the undergraduate body there are no men more interested in the college life of its members, or more self-sacrificing of time and energy in the furtherance of its aims, than the board of editors of *The Tech*.

We take pleasure in announcing that these gentlemen will furnish the material for this department.— EDITOR.]

SOCIETIES

IT is somewhat difficult to present to Technology Alumni such a review of the undergraduate life of to-day at the Institute, that each shall appreciate the forces working in our social system. The point of view is continually shifting, and the minor changes that take place from day to day almost imperceptibly revolutionize the old order of things. Except for a broad scientific training, the Institute offers little in common to the graduate of '68 and of '98, and because of this, it seems best to present the various phases of Institute life separately, though briefly, and from the standpoint of the present undergraduate body.

COLLEGE PUBLICATIONS. — *The Tech*, the college weekly, and oldest organization in the Institute, is beginning Volume XVIII. In eighteen years it has changed materially from its original character. *The Tech* now consists of from eight to twelve pages of reading matter, comprising editorials, college and athletic news, alumni notes, a short story, the "Lounger," an illustrated cover each week, and thirteen pages of advertisements. A determined attempt has been made to put the paper on a sound financial footing, and although the support from the Alumni has fallen off, the circulation among the undergraduates has increased. In short, *The Tech* has entered upon what promises to be a year of unusual prosperity.

The Junior Class is now engaged in the preparation of the "*Technique*, 1900." Judging from certain rumors, it is safe to predict that the book will contain features of exceptional interest to Technology Alumni.

The Institute Committee still suffers from lack of power to enforce any reforms. In dealing with the recent disgraceful disturbances accompanying the Freshman Class election it could only recommend that some action be taken by the several classes to prevent further disturbances in the Institute buildings.

Musical Clubs. — The Glee, Mandolin, and Banjo Clubs have formed an association among themselves for more convenient financial management, and this winter have made some very decided hits. The manager has taken pains to arrange for even more dances and receptions than were enjoyed last winter, and this feature of the trips is proving a great attraction. The clubs have some good musicians in them, and, as the representatives of the social side of undergraduate life, have met with decided success. On December 29th the clubs give a concert followed by a dance at Gloucester. The Wellesley concert has been set for January 7th, Springfield, January 9th or 11th, and Mt. Holyoke College, January 10th.

L'Avenir is to give the play next Junior week, an agreement having been made with the Walker Club to give plays alternate years. Rehearsals have begun, and a very creditable performance is assured. In addition to this work of preparation, L'Avenir still has weekly meetings, which are frequently addressed by French gentlemen.

Die Gesellschaft. — The present work of the society is a study of the history of German Literature, with Professor J. Keller's "Bilder Aus Der Deutschen Litteratur" as a text-book. The work is aided by lectures from members of the Faculty, with occasional illustrated talks. Certain German plays will be studied in detail, and the productions of local German companies will be attended.

M. I. T. Yacht Club. — The Yacht Club is one of the most successful clubs at Technology. The following yachts took

part in the annual cruise held in Narragansett Bay, in July: *Venture*, Commodore Swasey; *Fantasie*, E. Sturtevant; *Narona*, T. W. Brigham; *Lotus*, Morgan Barney; *Ellide*, W. T. Aldrich. Membership is restricted almost exclusively to yacht owners.

Tennis Association. — The fall tournament of the Tennis Association was the first held on the new courts on either side of Rogers. The courts were not in the best of condition, but an unprecedentedly large number of entries made it very interesting. In the finals, Street beat Thatcher in singles, 4–6; 4–6; 6–1; 9–7; 6–4. In doubles, Ayer and Thatcher beat Cutter and Saylor, 6–2; 7–5; 6–2.

ATHLETICS

Track Athletics. — In track athletics all our energies are ultimately directed toward winning the annual meet which takes place at Worcester, in May, between the New England colleges. In 1894 Technology won the championship. Last year we scored 21 points against the winner's 24, and lowered the records in the 220-yard hurdles and the two mile bicycle race. Nearly all of last year's team are back, and the outlook for the '99 meet is encouraging.

In football, despite the failure and disbanding in the middle of the season of the eleven of two years ago, this year's team has certainly made a record thoroughly creditable to the Institute.

The fall handicap games were held on Holmes Field, October 29th. The weather was cold and wet, yet the times in the running events were very good. This is particularly so in the two dashes, the quarter mile, half mile, and the two mile. The former two mile record was beaten by 32 3-5 secs.

One Hundred Yard Dash. — First heat, won by Hall, '00, 3 yds.; second, Burch, '99, scratch. Time, 10 4-5 sec. Second heat, won by Horr, '02, 2 1-2 yds.; second, Rowe, '01, 5 yds. Time, 10 3-5 sec. Final heat, won by Hall, '00, 3 yds.; second, Burch, '99, scratch; third, Horr, '02, 2 1-2 yds. Time, 10 1-5 sec.

Two Hundred and Twenty Yard Dash. — Won by Hall,

'00, 4 yds.; second, Burch, '99, scratch; third, Dutton, '00, scratch. Time, 23 1-5 sec.

Four Hundred and Forty Yard Dash.—Won by Dutton, '00, 7 yds.; second, Coleman, '01, 20 yds. Time, 52 3-5 sec.

Eight Hundred and Eighty Yard Run.—Won by Lathrop. '01, scratch; second, Garrett, '01, scratch; third, Wood, '02, 35 yds. Time, 2 min. 8 2-5 sec.

One Mile Run. — Won by Pray, '99, scratch; second, Field, '02, 15 yds.; third, Stockman, '01, 25 yds. Time, 5 min. 1 sec.

Two Mile Run. — Won by Pray, '99, scratch; second, Stockman, '01, 100 yds.; third, Field, '02, 60 yds. Time, 10 min. 44 4-5 sec.

One Hundred and Twenty Yard Hurdle.—Won by Horr, '02, 5 yds.; second, Wentworth, '00, 8 yds. Time, 19 1-5 sec.

Two Hundred and Twenty Yard Low Hurdles.—Won by Burch, '99, scratch; second, Horr, '02, 7 yds.; third, Hall, '00, 12 yds. Time, 26 2-5 sec.

Running High Jump.—Won by Baxter, '01, scratch; second, Winchester, 4 in.; third, Pember, '02, 4 in. Distance, 5 ft. 6 1-2 in.

Running Broad Jump. — Won by Fleming, '01, 18 in.; second, Horr, '02, scratch; third, Wentworth, '00, 1 ft. Distance, 20 ft. 3 1-2 in.

Pole Vault.—Won by Baxter, '01, 3 in.; second, Shephard, '01, scratch. Distance, 8 ft. 11 1-2 in.

Throwing 16-pound Hammer. — Won by Walton, '99, scratch; second, Wentworth, '00, scratch; third, Price, '00, scratch. Distance, 88 ft. 5 in.

Putting 16-pound Shot. — Won by Winchester, '02, 5 ft.; second, Wentworth, '00, 4 1-2 ft.; third, Kimball, '99, scratch. Distance, 38 ft. 11 1-2 in.

Throwing Discus.—Won by Fleming, '01, 15 ft.; second, Wentworth, '00, 10 ft.; third, Kimball, '99, scratch. Distance 94 ft. 11 in.

In order to induce more men to train regularly throughout the year, a member of the Athletic Association has offered two cups — one for the man who wins the most points in the weights, and the other for the one who has the most points in the re-

maining events. The meets in which the points count are those of this school year.

In September a letter was sent to every Freshman in the Institute to stimulate interest in athletics in general, but more especially in track athletics. Replies were solicited in regard to their athletic records. The letter was originally gotten up to induce the men to try for the track team, so that the captain would have a fair idea of the material in the entering class. Although the replies were not so numerous as desired, yet it may safely be said that the scheme has proven fairly successful.

Football. — In comparison with the teams of the last three or four years, this year's football team shows a great improvement. The team is seriously handicapped, however, by the lack of a convenient place for practice, and by poor financial aid. At West Point the men can practise only an hour a day, yet the football field is so convenient, and the graduates as well as the undergraduates take such a keen interest in the game, that they turn out one of the best "elevens" in the country.

Considering the conditions under which our men worked, the record of this year is remarkably good. Too much credit cannot be given Captain Morse. It is to his hard and conscientious work that the team owes much of its success.

Up to November 15th, Tech played 8 games, winning 5, losing 2, and tieing 1. A. E. Locke coached the team. In Captain Morse, Jouett, and Nolte we have some good backs able to follow interference and strong on defensive play. Maxson at quarter has proved himself to be a cool, heady player. He interferes well, and plays a brilliant defensive game. Heckle at tackle and end is the strongest player in the line, but he has been disabled for several weeks.

The following are scores of the games played up to November 15th. Oct. 8th, Tech 0, Trinity 0; Oct. 12th, Exeter 12, Tech 0; Oct. 15th, Tech 6, Andover 5; Oct. 22d, Tech 24, Worcester Tech 0; Oct. 29th, Amherst 10, Tech 6; Nov. 2d, Tech 22, New Hampshire State College 0; Nov. 9th, Tech 6, Boston College 0; Nov. 12th, Tech 8, Tufts 6.

Advisory Council on Athletics. — Some time ago a com-

mittee was appointed to investigate the subject of physical training at Technology. In accordance with the recommendation of this committee the Advisory Council on Athletics, consisting of three graduates and three undergraduates, was organized and given the supervision and control of the finances and policy of the Athletic Association. This council has done much to secure the confidence of the students and minimize the danger from mismanagement and ill-advised and hasty measures in conducting our athletics.

THE CANE RUSH. — The Freshman–Sophomore cane rush and football game took place on November 22d at the South End Grounds. The rush was awarded to the Sophomores, the score being 15 hands to 11; and the football game was won by the Freshmen by a score of 11 to 0. Transparencies, Freshman standards, and brass bands were conspicuously absent. The field, consequently, was almost totally deprived of the customary local color and variety of former rushes. The attendance was about eight hundred.

THE TECHNOLOGY CLUB

THE past year has been a most active and successful one in the life of the Club. There has been a steady increase in the number of members, and in the interest shown by members in all matters connected with the Club and the Institute.

In addition to the pleasure derived by the members in a social way from the Club, and more particularly from the special occasions mentioned in detail below, the Club has proved in many ways to be of the utmost importance to the Institute. It has been possible to show courtesies to societies and distinguished individuals, and to carry on several undertakings of great moment to the Institute that could not have been undertaken if the Club had not been organized.

Although the annual dues have been for resident members only $12, and for non-resident and undergraduate members only $6,

the running expenses of the Club have not exceeded the income, and all that is now required to put the Club on a most satisfactory financial footing is an increase of about one hundred in the list of members.

The condition of the membership at the beginning and end of the year is shown in the following table:

	Honorary.	Corporation.	Instructors.	Undergraduates.	Other Members.	Total.	Gain.	Resident Members.	Non-Resident.
Oct. '97	2	28	74	22	400	526	. .	428	98
Oct. '98	3	28	70	40	440	581	55	478	103

Besides numerous class and society meetings and dinners, there were held at the Club the following special occasions, at which the attendance varied from 50 to 250 members and friends:

October 22, 1897: Reception to the class of '98.

October 29: Smoke talk by Mr. Herbert Putnam, librarian of the Boston Public Library, on "Some Famous Thefts from Libraries."

November 8: Reception to President Crafts.

December 5: Smoke talk by Mr. F. Marion Crawford on "The Original Mr. Isaacs."

December 10: Pop concert by the Bohemian Orchestra.

December 17:[1] Smoke talk by Mr. Charles W. Hubbard on "A Canoeing Trip through English Canals and Rivers."

January 2, 1898: Concert by a string quartette, consisting of Mr. Charles L'Orage, Mr. William F. Steffens, Mr. Ernest Verron, Mr. Max Korth.

January 7:[1] Smoke talk by Dr. G. Byron Gordon, chief of the Honduras expedition of the Peabody Museum, on "Ruins and Explorations in Central America."

January 21:[1] Smoke talk by Mr. W. Lyman Underwood on "Birds, Animals, and Odd New England Characters, Caught by the Camera in their Native Wilds."

January 28: Smoke talk by Dr. Edward Everett Hale on "Old Boston, its Foundation, and the Laying Out of its Streets."

[1] These talks were illustrated with the stereopticon.

February 19: Reception to ladies.

February 25: Smoke talk by Prof. George F. Swain on "The Boston Subway," and by Prof. Alfred E. Burton on "The Determination of the Boundary between Massachusetts and New York."

March 2:[1] Smoke talk by President Mendenhall, of the Worcester Polytechnic Institute, on "Alaska."

March 12: Concert by the M. I. T. Glee Club.

March 18:[1] Smoke talk by Mr. Hiram A. Miller on "The Metropolitan Water Supply."

March 26: Concert by the M. I. T. Glee, Banjo, and Mandolin Clubs.

April 8:[1] Smoke talk by Mr. Arthur T. Hopkins on "Jamaica, Observations and Experiences."

April 14:[1] Smoke talk by Hon. Carroll D. Wright on "The Working Man's Complaint against the Courts."

April 27: Reception and dinner by the Faculty to Captain Bigelow.

September 26:[1] Smoke talk by Mr. Hiram S. Maxim on "Inventions in connection with Firearms."

Pool and whist tournaments were held during the winter.

The privileges of the Club were extended to students on Thanksgiving Day, to the members of the National Academy of Science during the meetings in Boston last winter, to the American Association for the Advancement of Science and Allied Societies during the summer meeting, and to the officers of visiting war-ships.

OFFICERS

President
James P. Munroe.

Vice-President
Francis H. Williams.

Treasurer
Edwin C. Miller.

Secretary
Dana P. Bartlett.

[1] These talks were illustrated with the stereopticon.

Executive Committee

James P. Munroe,

Francis H. Williams, Percival W. Pope,
Harry W. Tyler, Arthur T. Bradlee,
Edwin C. Miller, Dana P. Bartlett.

House Committee

Percival W. Pope,

Harry W. Gardner, Walter H. Kilham.

Membership Committee

Arthur T. Bradlee,

Arthur D. Little, Harvey S. Chase,
Andrew D. Fuller, Frederick W. Bailey.

THE GRADUATES

THE ALUMNI ASSOCIATION

THE year just closing marks a distinct change in the policy of the Association in the establishment of associate membership.

The writer well remembers about ten years ago when a proposition of this kind was overwhelmingly defeated, and now upon recommendation of a committee it was unanimously adopted. This portion of the constitution reads as follows:

"ART. II. Section 2. All graduates of the Institute shall be regular members.

"Section 3. Any other member of a class which has graduated, may become an associate member on election by the Executive Committee. Applications for associate membership shall be submitted in writing through the secretary of the Association, to a Membership Committee of seven, which shall meet at least twice a year, and names of persons recommended by the Committee for associate membership shall be reported to the Executive Committee, and the

names of those elected by the Executive Committee shall be announced by the secretary in connection with the call for the next ensuing meeting of the Association."

To avoid the inconvenience of remitting a dollar annually, a provision for life membership of twenty dollars has been made. This sum was fixed after careful consideration and consultation of the life expectancy tables of insurance companies. These show that the average person of twenty-three, the average age at graduation, may expect to live forty years; from the percentage of mortality of the thirty classes which have graduated, it is found that the length of life very much exceeds the average figure; hence the sum named is considered fair to all.

As the result of a conference between representatives of the Corporation, Alumni Association, and students, an advisory Council on Athletics has been established. This consists of three past students of the Institute elected by the Alumni Association; three undergraduates elected by the Athletic Association, the Football Association, and Institute Committee, and these to choose a general treasurer, not an undergraduate, which seven "shall regulate the general athletic interests of students of the Institute . . . and have final jurisdiction in all matters pertaining thereunto."

The report of the Alumni Committee on the School, Messrs. Locke, Rollins, and Cunningham, was one of the most important ever rendered. Its chief object was to show the achievements and strength of our Alma Mater. The closing paragraph, which seemed to be particularly appropriate, was as follows:

"We have glanced at the phenomenal growth of the Institute and the position it has attained among educational institutions as a leader along new lines, as an exponent of new methods. By its entire independence from hampering traditions, by the devotion of its faculty and directors, by its modest, thorough work under its great presidents, its world-wide reputation has been won in little more than thirty years. It is this precious trust, so justly dear to our loved and honored president, the late General Walker, that is in part confided to us as Alumni; and we must see to it, so far as

in us lies, that no circumstance, whether of lack of means or of other nature, shall interfere with the fullest and freest development of the educational principles for which our Alma Mater stands."

It is to be regretted that, financially, the Association is meeting with only half-hearted encouragement. Instead of having a surplus, as we should have from 1,689 members, our receipts barely meet our expenditures, the secretary frequently being obliged to advance funds for postage. The accompanying statement of dues outstanding is interesting, and at the same time depressing.

YEAR.	PAID.	DUE.	TOTAL.
1898	$590[1]	$1,099	$1,689
1897	624	894	1,518
1896	683	651	1,334
1895	609	588	1,197

The difficulty appears to be with the younger classes, which do not seem to realize that by their graduation from the Institute they become members of its Alumni Association; and that the payment of its dues may be taken as a mark of their loyalty and esteem for their Alma Mater.

THE NORTHWESTERN ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

President, B. R. T. Collins, '88; *Vice-President*, R. H. Pierce, '85; *Secretary and Treasurer*, E. McK. Hagar, '93, 554 The Rookery, Chicago, Ill.; *Executive Committee*, the president, vice-president, secretary and treasurer, H. H. Cutler, '81, J. L. Shortall, '87, Solomon Sturges, '87, L. A. Ferguson, '88.

Monthly dinners at "The Bismarck," 180 Randolph Street, on the sixteenth of each month, 6.30 P. M. All Institute men are invited.

[1] Not including 41 life memberships.

THE WESTERN ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

President: Edward W. Rollins, '71.

Vice-President: Bradford H. Locke, '72.

Secretary and Treasurer: Frank E. Shepard, '87, 924 Washington Avenue, Denver, Col.

The Western Association has not had a meeting in some time. Its members are largely in the mining profession, and are rather widely separated. They are thoroughly loyal to the Institute, however, and the influence of the Association is vital.

THE M. I. T. SOCIETY OF NEW YORK

The organization meeting of this Society was held at the Central Roof Garden, No. 143 Liberty Street, on June 8, 1895, it having been called by a circular sent out to the Alumni and former students of the Massachusetts Institute of Technology, residing in and about New York City, undersigned by Harry P. Barr, Chas. W. Eaton, Alex. Rice McKim, Edgar H. Mumford, Frank A. Pickernell, and Charles R. Richards, all members of the class of '85.

Article 2 of the Constitution shows its motive:

"The object of 'The M. I. T. Society of New York' is to bring together former students of the Massachusetts Institute of Technology residing in or about New York City for the purposes of social intercourse and mutual advantage, and also to forward the interests of the Alma Mater."

The Society now numbers nearly one hundred members, and is in a flourishing condition. Its executive committee consists of the following men: George L. Heins, '82; William B. Dowse, 74; Frank A. Pickernell, '85: Edward R. French, '92; Alex. Rice McKim, *Secretary and Treasurer*, 106 East Twenty-third Street, New York.

On the afternoon of Saturday, September 24th, the members

of the society visited the navy yard and inspected the *New York*, the *Texas*, and the *Oregon*.

The next annual meeting will be held on Saturday evening, February 4th. All Tech men who can be in New York City at that time should notify the secretary, Mr. Alex. Rice McKim, at 106 East Twenty-third Street.

We regret to hear of the death of Edward Dexter Brown, '90, general inspector of the American Telephone and Telegraph Company, who was taken ill while at Camp Alger, Va., where he was in camp with Troop C of the U. S. Volunteer Cavalry, and died on July 16, 1898, at Fort Myer Hospital, Washington. Mr. Brown was one of the most energetic and promising Tech men in New York. His kind, thoughtful, and generous nature had won the esteem of both business and social friends.

THE CONNECTICUT VALLEY ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Connecticut Valley Association sprang from the desire to bring together the Alumni and further the interests of the Institute in this region. The movement was started by Mr. Giles Taintor in the fall of 1893. A list of Technology men of the region, as complete as possible, was made, and a call was sent out. The response was general and hearty. A dinner was held at Hotel Worthy, Springfield, Mass., in February, 1894. General Walker attended and made a speech that warmed all hearts. Dr. Harry W. Tyler, secretary of the Institute, and Mr. James P. Munroe, of the Boston Alumni Association were also guests, and made most acceptable addresses. Some fifty or sixty of the Alumni were present and an organization was effected. This organization was of an informal and elastic nature, as best suited the situation. Power to make all arrangements and to transact all necessary business was vested in an executive committee of five, these to choose chairman, secretary, and treasurer from their own number.

Mr. Taintor was first chairman, Mr. Guy Kirkham, of Spring-

field, secretary, and Mr. James S. Newton, of Holyoke, treasurer. Mr. N. P. A. Carter, of Chicopee Falls, Mass., Mr. Henry Souther, of Hartford, Conn., Mr. Francis, of Pittsfield, Mass., and Mr. George H. Munn, of Easthampton, Mass., have served on the executive committee. It was provided that a new committee-man be elected each year, the chairman of the preceding year retiring. The expenses of the Association are met by a small initiation fee and annual dues. It is proposed to issue a directory of the Connecticut Valley Alumni as soon as the list can be made approximately complete. The territory covered by existing membership extends from Burlington, Vt., on the north, to Stamford, Conn., on the south, and from Warren, Mass., on the east, to Pittsfield, Mass., on the west.

At the second dinner, held at the Massasoit House, Springfield, Mass., in March, 1895, Professor Homer, of the Architectural Department of the Institute, was the guest and principal speaker. The following winter the dinner was omitted out of respect to General Walker's memory. In November, 1896, a dinner was held at the Hotel Worthy, and the Association welcomed President Crafts, who spoke concerning the plans, hopes, and needs of the Institute. Colonel Halstead and others were guests and speakers.

It is the hope of the executive committee that all Tech men in the region will see that their names and addresses are on the rolls and will rally at the call of the next dinner. Names may be sent to N. P. A. Carter, Carter Electric Co., Springfield, Mass.

THE TECHNOLOGY SOCIETY OF PHILADELPHIA

Secretary-Treasurer, Samuel S. Sadtler, '95; *Executive Committee*, Amos J. Boyden, '75, Samuel Neidich, '98, Augustus B. Stoughton, '86, Benjamin Adams, '95. Annual dinner second Saturday in in November; semi-annual dinner in April.

The third and, in many respects, most successful meeting of the Tech Society of Philadelphia was held in the Colonnade Hotel on Saturday evening, November 19th. The classes represented ranged

from '74 to '98. Neidich, '98, was the new member elected for the executive committee to fill the place of Logan, '92, whose term had expired. The other officers are as formerly.

Mr. Amos J. Boyden, '75, acted as toastmaster, and Capt. D. A. Lyle, '85, U. S. A., W. R. Webster, '75, J. C. Miller, '74, E. V. Seeler, '91, Benj. Adams, '95, and others responded to toasts. The society definitely decided to have weekly lunches at a central point and to amend the constitution so as to have a semi-annual business meeting at the discretion of the executive committee. It was also decided to make a second amendment providing for the annual election of a president, who shall also act as toastmaster. A new directory will shortly be made out and distributed.

The Society hopes before long to undertake some useful work in behalf of the Institute, but plans will not be made known at present.

PITTSBURGH ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The first steps to bring together the Tech men in or near Pittsburgh were made early this year by Mr. Francis S. Vielé of the class of '91. Mr. Vielé had seen the success which, some years previously, had attended the efforts to form a similar society in Chicago. After considerable work he issued, on March 25, 1898, a letter to all the Tech men available, briefly calling for an expression of opinion on the subject of an organization. A very encouraging number of answers was received. On the strength of the spirit shown by these replies a dinner was arranged. This dinner, held at the Hotel Henry, Pittsburgh, April 9th, was the preliminary meeting of the Association. Thirty Tech men were present. Mr. F. E. Alden, '79, was chosen acting chairman. It was unanimously voted that a permanent organization be formed, which should be called the Pittsburgh Association of the Massachusetts Institute of Technology, and that the officers of the Association consist of president, vice-president, secretary and treasurer; these officers to constitute the executive committee.

The following officers were elected: *President*, F. E. Alden, '79; *Vice-President*, F. S. Vielé, '91; *Secretary and Treasurer*, H. D. Shute, '92. It was voted that the Association should have no by-laws.

A directory is about to be published. It will be of interest to all our members, especially in view of the conditions of Pittsburgh business life. There is in Pittsburgh no central business district where technical men are likely to meet during the day. The mills, glass works, machine shops, electrical factories, etc., employing Institute men, are widely separated, miles apart. It is therefore difficult for the men to keep in close touch. By means of a directory of names, telephone numbers, and addresses, it is hoped that this disadvantage may be somewhat modified.

"TECH" SOCIETY OF WESTERN NEW YORK

A preliminary meeting to organize a "Tech" Society of Western New York was held at the University Club of Buffalo, Thursday evening, July 7th, 1898. The following were present: Henry A. Boyd, '78, Harry T. Buttolph, '76, Loring N. Danforth, '97, W. A. Faxon, '97, William G. Houck, '93, Harry L. Noyes, '90, Maurice B. Patch, '72, N. K. B. Patch, '01, C. W. Ricker, '91, F. M. Conant, '96, H. M. Loomis, '97.

Mr. Maurice B. Patch, '72, was elected temporary chairman, and Mr. C. W. Ricker, '91, temporary secretary, to serve until a permanent organization should be effected and the regular officers elected to succeed them.

The meeting then proceeded to the discussion of the form of organization required. It was arranged that the President appoint a committee of five of which he should be a member to draft the constitution and by-laws and arrange for the first regular meeting of the Society to take place in the latter part of September. At this meeting Maurice B. Patch, '72, Elgood C. Lufkin, '86, Henry A. Boyd, '79, Darragh de Lancey, '90, and Charles W. Ricker, '91, were chosen for executive committee, Ricker being

secretary-treasurer. Twenty-six men were present on this occasion, and the Society has now fifty members and is in a most flourishing condition.

THE ASSOCIATION OF CLASS SECRETARIES

One of the evidences of, and an important factor in the new life at the Institute, is the Association of Class Secretaries. This organization is the outgrowth of an informal gathering of a number of graduate secretaries at the Technology Club, on Nov. 4, 1896, in response to an invitation from the executive committee of the club. Its sole officers are a secretary and assistant secretary, and its object is "to promote class spirit and the welfare of the Institute, and to systematize all matter pertaining to class organization and record." Its headquarters are at the Technology Club, and its membership comprises the secretaries of all graduate classes, the president and secretary of the Alumni Association, the president of the Technology Club, the secretary of the Institute, the president of the Senior Class in the Institute, and a representative of the Institute Committee. A class without a secretary, or a secretary unable to attend, may appoint a representative with full powers. It is thus that full meetings are secured.

As an immediate result of the work of this association, all but two classes (whose total membership is only eleven graduates) are now definitely organized, and the classes of '97 and '98 have been assisted in perfecting their graduate organizations.

It has provided a ready means of directly reaching and interesting the entire body of nearly two thousand graduates and about an equal number of former students whose courses were not completed.

The benefits of united effort are to be seen in the adoption of a standard size for class publications; in the preparation of a uniform style of index card for membership lists; in the presentation by individual classes of several useful gifts to the Technology Club; in the inauguration of the custom of recognizing, in fitting

manner, at the annual reception of the Alumni Association, the class which graduated twenty-five years before; in the appointment of a committee to consider the matter of a Walker Memorial Fund, and in other ways more or less important.

An important work has been that of preparing a list of all graduate class publications, which now number about 150. Of these a large number have been collected, many in triplicate, for the purpose of depositing one set at the Technology Club, one at the Institute, and one at the Boston Public Library.

The greatest undertaking, and it is to be hoped the most lasting and influential, has been the publication of this magazine. The matter was first suggested by Mr. A. D. Little at a meeting of the Association held February 1, 1897. A committee consisting of Messrs. Little, Allen, and Munroe (the same as the present committee on publication), was appointed, several carefully prepared reports were made, and it was finally voted unanimously, on May 3, 1898, "That the committee on THE TECHNOLOGY REVIEW be, and hereby is, empowered to proceed and publish the said Review on behalf of this Association."

The present officers of the Association are:

Walter B. Snow, *Secretary*, Watertown, Mass.

Frederic H. Fay, *Assistant Secretary*, 60 City Hall, Boston, Mass.

NEWS FROM THE CLASSES.

[The success of this department must depend on the items furnished. It is earnestly requested that the members of the classes will assist their class secretaries by sending any possible materials to them or direct to the Editor.]

1868.

PROF. R. H. RICHARDS, *Sec.*
Mass. Inst. Technology, Boston.

William Jackson, city engineer of Boston, is a native of Brighton, born March 13, 1848, son of Samuel and Mary Wright (Field) Jackson. His first ancestor in this country was Edward Jackson, who settled in Newton in 1639. His early education was obtained in the public schools of Brighton; and he was fitted for his profession as a civil engineer at the Massachusetts Institute of Technology, which he entered in 1865, with the class of 1868. From the Institute he went directly to a position at the Chestnut Hill Reservoir of the Boston Water Works, where he was employed from 1868 to 1870. Then he was assigned to the water works survey and the extension of the system in Brighton and West Roxbury. With this work, and with the private practice of engineering, he was occupied until 1876, when he was appointed assistant engineer on the Boston Main Drainage Works, one of the most important pieces of engineering construction ever undertaken in Boston. He continued in this department until April, 1885, and was then elected city engineer in place of Henry M. Wightman, deceased, which position he has held since. During the construction of the Harvard Bridge over the Charles River, from 1887 to 1891, he was engineer for the Bridge Commissioners; and he is now chief engineer of the new Charlestown bridge and chief engineer of the proposed new Cambridge bridge. In 1891–92 he was a member of the Boston Rapid Transit Commission. He is a member of the American Society of Civil Engineers, of the Boston Society of Civil Engineers, of the New England Water Works Association, and of the Union, Art, and Technology Clubs of Boston, also of the Society of Colonial Wars. Mr. Jackson was married April 27, 1886, to Miss Mary Stuart MacCorry, of Boston. They have one child, William Stuart Jackson.

(S. E. T.)

1869.

HOWARD A. CARSON, *Sec.*
20 Beacon Street, Boston.

1870.

PROF. CHARLES R. CROSS, *Sec.*
Mass. Inst. Technology, Boston.

Edmund K. Turner is a candidate for Director of the Amer. Society of Civil Engineers at the coming election.

1871.

EDWARD W. ROLLINS, *Sec.*
Denver, Colo.

Henry M. Howe is professor of metallurgy at Columbia University. — G. Russell Lincoln is studying in Germany. — Charles F. Stone is treasurer of the Waltham Savings Bank, Waltham. — I. S. P. Weeks is chief engineer of the Burlington and Missouri River R. R. at Lincoln, Neb. — Edward W. Rollins has again taken up residence in Denver as president of the Denver Consolidated Electric Company and representative of E. H. Rollins & Sons, Bankers.

1872.

PROF. C. FRANK ALLEN, *Sec.*
Mass. Inst. Technology, Boston.

Dr. Charles Sedgwick Minot will deliver two lectures in Boston University, at the instance of the Twentieth Century Club, on the "Development of the Brain." — Maurice B. Patch is superintendent Buffalo Smelting Works, Calumet and Hecla Mining Company, and has a son who is a Sophomore at the Institute in Course II. — Benjamin E. Brewster was married last June at Hyannisport to Miss Grace Barnard, of Savannah. — William B. Dodge died at Columbus, Ohio, January 29, 1898. An account of his life will be furnished in the next number.

1873.

SAMUEL E. TINKHAM, *Sec.*
City Hall, Boston.

From the *Hawaiian Gazette* comes news of the death of Theodore C. Porter, who was a student at the Institute in its early days. He was born in Duxbury, and soon after leaving the Institute went to the Pacific coast and later to Honolulu. As an expert accountant, both with William G. Irwin & Co., and later with Claus Spreckles & Co., he made a reputation which led to his becoming Minister of Finance under the Provisional Government soon after its organization. His private and public duties

proved together too much for his health, and brought upon him nervous disorders which caused his breaking down and ultimately led to taking his own life. He died February 28, 1898, in California, where he had gone for rest and health. While at the Institute he was distinctly of a companionable nature, and very readily made friends. He seems to have retained these characteristics in his island home, where he was highly respected personally, as well as officially. He was regarded as a man of high ability, unblemished character, and held many positions of trust and responsibility. His integrity was almost a maxim in business circles. The mathematical training received at the Institute was evidently the foundation for the business success which he secured. His family consisted of a daughter five years old and his wife, formerly Mary Savidge of Honolulu, to whom he was married thirteen years ago. The writer's memory of him is of a loyal, frank, and open-hearted friend. (C. F. A.) — Captain Ripley was in Cuba all through the war, and had an interesting experience.

1874.

CHARLES F. READ, *Sec.*
47 Cypress Street, Brookline.

The Association of the Class of 1874 is making arrangements to celebrate in January, 1899, the twenty-fifth anniversary of the graduation of the class. It is to be a ladies' night, and it is hoped that not only will the wives of the members be present, but also such professors of the Institute as taught there during the period 1870–1874. — Walter L. B. Bouvé was a student at the Institute in the class of '74, and later entered the legal profession. At the breaking out of the war with Spain he left his business and entered the service of the Commonwealth as first lieutenant of the First Corps Cadets at Nahant, on coast defence. In June he was placed in command of a detachment at Hull, being stationed at the old fort on Telegraph Hill. On May 13, 1898, he was commissioned assistant adjutant-general of volunteers with the rank of captain, to rank from May 9th. June 18th he was assigned as assistant adjutant-general to the Third Brigade, Third Division, First Army Corps, commanded

by Brigadier-General Andrews, Colonel Twelfth U. S. Infantry, stationed at Camp George M. Thomas, Chickamauga, Georgia. September 1st he was stationed at Camp Hamilton, Lexington, Ky., and September 24th was honorably discharged. He has now resumed the practice of his profession and has recently been reëlected a member of the Massachusetts Senate.

1875.

E. A. W. HAMMATT, *Sec.*
29 Pemberton Square, Boston.

M. D. Burnet, ex-Mayor of Ocala, Fla., is in the banking business in Syracuse, N. Y. — E. A. Handy, chief engineer L. S. & M. S. Ry., was in Boston recently, and called on several of the '75 men. — C. M. Boutelle, superintendent of schools, Marshall, Minn., had the degree of LL.D., conferred by St. Stephen's College, of Annandale, N. Y. — E. S. Dorr, who has been for nearly twenty years with the sewer department of the city of Boston, is at present acting deputy superintendent of sewers. — J. B. Stanwood, of Houston, Stanwood & Gamble, engine builders, Cincinnati, is one of the council of the American Society, Mechanical Engineers, a member of the Manufacturers' Club and Chamber of Commerce, of Cincinnati, Ohio. — F. S. Dodge, who took an active part as a lieutenant of sharpshooters at the time of the "Revolution" in Hawaii, is supposed to be still located at Honolulu, as he has not been heard from since his return from England, where he went on government business. — S. L. Abbott, Jr., is secretary and treasurer of the San Francisco Golf Club, as well as secretary of the Security Savings Bank. It is some time since Abbott has been heard from. — Chas. W. Goodale is agent of the mining department of the Colorado Smelting and Mining Co., at Butte, Montana. He has been an alderman, and is a trustee of the Montana State School of Mines, as well as a member of several scientific societies. — Wm. A. Mason is director of drawing in the public schools of Philadelphia. — The secretary would say that only about twenty per cent. of the class have sent in replies to his circular for information desired in making up a new class directory. Please send in reports promptly, that work on the same

may go forward. — H. L. J. Warren, who has been on the missing list for several years, called on the secretary one day during the summer; he was to send in a report of his wanderings, and his address, but so far nothing has been heard from him. — It is reported that J. B. F. Breed is assistant engineer for the Board of Public Works, Toledo, O. — The secretary would consider it a favor if any one ever connected with '75, knowing the present address of any '75 man, would send the same to him at 29 Pemberton Square, Boston, Mass. This will help to correct his list of addresses, and enable class notices to be more surely sent.

1876.

JOHN R. FREEMAN, *Sec.*
Providence, R. I.

Professor Holman's new book on "Matter and Energy" is just out, and we are able to print a capital review of it on another page. It will be a source of gratification to Professor Holman's friends that he is able to give us this ripened fruitage of his mind. — Capt. Alfred E. Hunt is being prominently advocated for mayor of Pittsburg, Pa. He has returned from the seat of war, and is rapidly recovering from the effects of a malarial fever. He was an actor in one of the most dramatic incidents connected with the closing of hostilities in Porto Rico. Hunt, who commanded a company in the cadet corps of the M. I. T. under Zalinski in 1873, and who has ever since been an ardent military man, has for about ten years past been captain of the crack battery of Western Pennsylvania in the State's "National Guard," and immediately on the breaking out of hostilities offered his services to the government, and, with his battery, was promptly mustered in and ordered first to Chattanooga, and later to Porto Rico. It was this Battery B, Pennsylvania Volunteers, which was at the front with General Brooke, and had just been drawn up in line for firing on the Spanish outposts when the messenger bringing the news of the signing of the protocol appeared. This incident was given a double page picture in *Harper's Weekly* recently, but unfortunately the artist was some miles in the rear when the incident occurred, and Hunt was sick with malarial

fever a few days later, when the artist requested the battery to pose for their photograph, so it is hard to recognize his likeness in the picture. Almost as the messenger arrived, a Mauser bullet passed between Captain Hunt and General Brooke, who were standing near together, and buried itself in a clay bank; this the captain preserves as a souvenir. Five minutes more and the battery would have been in action. Hunt's dream of a lifetime of being in a real live battle was thus suddenly crushed, and, as he and his associates confess, some of their language for the next few minutes, or days even, would not look well in print. — C. L. Rich has been a member of Troop A, New Hampshire National Guard, for six years.

1877.

RICHARD A. HALE, *Sec.*
Lawrence, Mass.

A class directory has recently been published which has furnished good reading to those privileged to see it. Besides an excellent photograph of those present at the last class dinner, there are also most interesting personal letters from members of the class.

1878.

LINWOOD O. TOWNE, *Sec.*
Haverhill, Mass.

Takuma Dan was here in September from Japan, to the delight of those able to meet him. He was pleased with the growth of the Institute. — The secretary has recently conducted two excursions of the Haverhill High School boys to the Institute. The boys listened with delight to the stories of the old days, while they were being shown through the laboratories.

1879.

HARRY H. CAMPBELL, *Sec.*
Steelton, Pa.

Several of the men have gone into business life through their fathers' connections. Frederic H. Lane, of Allen, Lane & Co., Edwin C. Miller, of the Miller Piano Co., and Frederick S. Coffin, of Stoddard, Haserick, Richards & Co. — Arthur M. Waitt is general master car builder, Lake Shore & Michigan Southern Ry. at Cleveland, and William Otis Dunbar is in charge of Pennsylvania R. R. Test Department, Altoona, Pa. Samuel T. Braley is in charge of the scale design and pattern departments of the Howe Scale Co. at Rutland, Vt. — But one

graduate of this class in Course II. has passed beyond. Edward H. Owen, Jr., died in 1890. A bright future was before him in his chosen profession, mill engineering. For some years before his death he was obliged to live in Colorado, but, in spite of ill health and feebleness, he made a strong impression on those he met, and his friends still mourn his loss.

1880.

PROF. GEO. H. BARTON, *Sec.*
Mass. Inst. Technology, Boston.

Charles H. Brown visited Boston and the Technology Club recently, to the sincere pleasure of those whom he met.

1881.

FRANK E. CAME, *Sec.*
17 Place d'Armes Hill, Montreal.

Frank West Rollins was born in Concord, New Hampshire, February 24, 1860, son of Edward Henry and Ellen (West) Rollins. His family has been prominent in the affairs of the State for more than two centuries; his father represented New Hampshire in both houses of Congress. He was educated in the schools of Concord by Moses Woolson, at the Massachusetts Institute of Technology, and at the Harvard Law School. He was admitted to the bar in August, 1882. After practising his profession for a year he entered the banking house of E. H. Rollins & Sons, becoming vice-president of the house after its incorporation, and taking charge of the Boston office, although he retained his residence in Concord. In politics he is a Republican. In 1895 he was elected to the State Senate, of which he was chosen president. He has served in various capacities in the National Guard, from private to assistant adjutant-general with the rank of lieutenant-colonel. He is an attendant of the Episcopal Church and a trustee of St. Mary's School for Girls. He has written much and well, his published works including "The Ring in the Cliff," "Break O' Day Tales," "The Twin Hussars," and "The Lady of the Violets," besides many magazine articles and short stories. In 1893 Dartmouth conferred upon him the degree of M. A. Mr. Rollins, who is an able speaker, made the address for the New England delegation, which journeyed to Canton to visit Mr. McKinley in 1896. In the last

election he was made Governor of New Hampshire.

1882.

WALTER B. SNOW, *Sec.*
Watertown, Mass.

Edward G. Gardiner is spending the winter in Europe. — The recently dedicated church for the First Free Baptist Society on Warren Street, Roxbury, Mass., was designed by Alfred L. Darrow. — Clark Carson, the class boy, who is now fourteen years old, is preparing for the Institute at the Lawrenceville School, Lawrenceville, N. J. He expects to take a course in naval architecture. — George E. Warren has been abroad in the interests of the Goodyear Shoe Machinery Co., with which he is connected. — The new Terminal Station of Boston, the largest in the world, was designed by Shepley, Rutan & Coolidge. Mr. Shepley of this firm was a special architect in the class of '82. The design which so long graced the cover of *The Tech* was from his pen. — T. B. Carson, who is located at Davenport, Iowa, was recently in Boston, and was entertained by a number of old classmates at an informal dinner at the Technology Club on October 31st. This was the first time their acquaintance had been renewed since graduation, and many were the pleasant reminiscences. French, Low, Jenkins, Munroe, Ross, Snow, and Walker were in attendance. — James P. Munroe has been elected a member of the Corporation of the Institute during the past year. — The present address of Mrs. Carrie Rice Clark is Ford Hotel, Phoenix, Ariz. — Walter H. Hersey, who was until recently the superintendent of the Lymansville Co., Providence, R. I., is now connected with the Lodge Double Comber Co., of the same city. — George W. Mansfield has severed his connection with the Norwalk Tramway Co., and is now at his home in Melrose Highlands, Mass. — R. F. Herrick, who was until recently general superintendent of the Liondale Bleach, Dye, and Print Works at Rockaway, N. J., was at the Institute last summer taking up advanced organic chemistry, and is now acting as consulting industrial chemist. His home address is 22 Herrick Street, Winchester, Mass. — James P. Munroe is chairman of the Massachusetts Reform Club Committee of

the Anti-Imperialist League. — Walter B. Snow has recently lectured on the subject of "Mechanical Draft for Steam Boilers" at M. I. T., Harvard, Yale, and Columbia. — Alfred L. Darrow has changed his place of residence to 25 Harris Street, Cambridge. — Harry G. Manning and Walter B. Snow have been elected to membership in the American Society of Mechanical Engineers during the past year. — Information is desired regarding Frank C. Morrison. His last address was San Francisco, Cal., but nothing has been heard from him for nearly two years. — The model foundry plant of the Walker & Pratt Mfg. Co., of Watertown, Mass., which is the embodiment of the ideal fostered for years by Arthur W. Walker, has hardly an equal and undoubtedly no superior in the country. It is the Mecca of all progressive foundry men. — Of all the persons so far admitted to associate membership in the Alumni Association, more than half are members of the Class of '82. Over fifty per cent. of the graduate members of the class are also members of the Technology Club.

1883.

HARVEY S. CHASE, *Sec.*
8 Congress Street, Boston.

The class gift to the Technology Club (a library of President Walker's works) will be installed in the club as soon as two new volumes, now in press, are published. — Some replies to secretary's circulars concerning the fifteenth Year Book are yet to be received. — Class meeting early in 1899 will be held at the Technology Club. — Geo. J. Foran, with Geo. F. Blake Mfg. Co., has recovered from a severe illness lasting the greater part of the year. — Horace B. Gale barely escaped an election to the Legislature at the recent balloting in Natick, Mass. — H. T. Bardwell appeared recently and looked over the club. — R. T. Gibbons did the same some time ago, as also G. H. Bryant, who is doing extremely good work as principal of the Townsend Industrial School at Newport. — The secretary desires all members, graduates, or specials to consider themselves welcome at his office at all times. A lunch at the club is a good thing! — F. O. Harriman was the owner, a year or two ago, of a large ranch in Mexico,

having gone there as engineer on railroad work. He married and settled there, but we have had no recent word from him.

1884.

PROF. A. H. GILL, *Sec.*
Mass. Inst. Technology, Boston.

Quite a number of the class have, during the past year, completed that age of man which may be designated as the house building or house owning period. Among these are R. L. Chase North Adams, E. D. Mellen, 1590 Massachusetts Avenue, Cambridge, H. W. Tyler, Newton Centre, and the secretary. — Holder has been out of health for some time, the cause being nervous dyspepsia, but is recovering and is now able to attend to business. — In addition to his usual exacting duties, Tyler found time to serve as secretary of the local committee of the A. A. A. S., and to compile for the visitors a most useful "Handbook of the Scientific Institutions of Boston and Vicinity," which every one must have appreciated. — Bartlett came East for the summer and has changed little since '84. — Kennard is with the U. S. Sugar Refining Co., in Waukegan, Ill., where he has been for the past eight years. He writes that his lines have fallen in pleasant places. — The death of Heywood came as a great shock and surprise to us; he was the sixth member of the class to pass beyond. George Henry Heywood was born in Gardner, Mass., July 28, 1862; his parents were Henry Heywood and Martha Temple Heywood. He was educated in the public schools of his native town, until his graduation from the High School as valedictorian of his class in 1880, after which he completed the course in mining engineering. He then entered the office of Heywood Bros. & Co., in Gardner, and the following year went to Boston to open a branch store over which he had charge, and where he remained for about two years. He returned to Gardner, still retaining the general management of the Boston store, and in the following year went to Chicago to inaugurate the new enterprise of the Heywood & Morrill Rattan Co., superintending the erection of a large factory and also the opening of a retail store. After living in Chicago three years he returned to Gardner, and became, next to his father,

Mr. Henry Heywood, the leading spirit in the business, and at the time of the consolidation of Heywood Bros. & Co. with the Wakefield Rattan Co. he was made treasurer and a director in the new company. He was married, October 27, 1886, to Harriett G. Edgell, of Gardner, and left three children, Seth, John, and George Henry. After his return to Gardner to take up his permanent residence, he showed great interest in the affairs of the town, and for six years served on the school committee, being chairman of that body during the last three years, and was directly instrumental in the introduction of advanced measures for management of the committee and the schools. He was a Democrat in politics, a prominent member of the First Congregational Parish, a member of Hope Lodge, F. and A. M., North Star Chapter, R. A. M., Ivanhoe Commandery, K. T., and a member of the Massachusetts Consistory, president of the Gardner Boat Club, and one of the directors of the Public Library. His death occurred at Haines' Landing, Rangeley Lakes, Maine, where he had gone about two weeks previously with Mrs. Heywood for rest from his business, and to enjoy the fishing, and was caused by heart disease. He passed away while asleep, in the early morning of Tuesday, May 17th.

1885.

ARTHUR D. LITTLE, *Sec.*
7 Exchange Place, Boston.

Josiah Pierce, Jr., served as colonel on General Grant's staff in Porto Rico. — Donald MacRae, secretary and treasurer of the Wilmington Cotton Mills, Wilmington, N. C., is captain of Company K, Second Regiment, North Carolina Volunteers. — Alfred C. Fuller, who for some years has been in India in charge of the American Baptist Telugu Mission at Polili, Nellore District, has returned to his home, 125 Prospect Street, Cambridgeport, Mass. — The secretary has received an interesting letter from John T. Haines, first lieutenant and quartermaster, Fifth U. S. Cavalry. At the breaking out of the war Haines was stationed at Fort Sam Houston, Texas, but is now in Porto Rico. He served as instructor for four years at the Infantry and Cavalry School, Fort Leav-

enworth, Kansas. — Arthur K. Hunt is a corporator of the Portland Savings Bank, a director of the Merchants National Bank, and president of the Central Wharf Association, all of Portland, Maine. — The secretary desires information of the following men: W. A. Chapman, B. F. Copeland, W. D. Fuller, Robert R. Goodrich, Lansing O. Kellogg, William H. Parker, C. Stanley Robinson, Richard C. Weis. — Fred M. Kimball superintended much of the work of laying mines in Boston Harbor last spring. — Arthur H. Doane is general agent, sales department, Union Pacific Coal Co., Denver, Col. — Oakes Ames is general manager of the Kinsley Iron and Machine Co., Canton, Mass., and a member of the executive committee of the Lamson Consolidated Store Service Co. — Redington Fiske, who has been for several years with the New England Telephone and Telegraph Co., as superintendent of exchanges, has resigned that position to become vice-president and general manager of the Planters Compress Co., 89 State Street, Boston. — Arthur D. Little has been elected a Councilor of the American Chemical Society and to the Board of Governors of the Puritan Club. — The recent appointment of Charles R. Richards to the head of the Manual Training department of the Teachers' College of Columbia University has been the occasion of numerous appreciative notices of his work as a pioneer in manual training. Richards went immediately from the Institute to the Whittier Machine Company, with whom he remained until 1887 as assistant superintendent. He then received a call to the Industrial Education Association. which was the direct predecessor of the present Teachers' College with which he is now identified. In 1888 he was selected to take charge of the newly organized department of Science and Technology of Pratt Institute, where he remained for ten years as a member of the faculty and director of his department. Richards is president of the American Manual Training Association and has written several treatises and monographs on the methods and theories of manual training.

1886.

PROF. ARTHUR G. ROBBINS, *Sec.*
Mass. Inst. Technology, Boston.

Prof. Dana P. Bartlett is one of the candidates for School Committee of Boston. He is nominated and supported by the Boston Public School Association. — Edward E. Higgins, editor *Street Railway Journal*, paid a visit to the Institute recently. He has the honor of being the first subscriber to THE TECHNOLOGY REVIEW. — Prof. Arthur A. Noyes is president of the Northeastern Section of the American Chemical Society.

1887.

EDWARD G. THOMAS, *Sec.*
4 State Street, Boston.

This class has established a class fund which, it is expected, will amount in a few years to a sum of considerable size, sufficient to allow the class to assist its needy members or their families, and especially to enable it to act promptly in any emergency. In the end the fund will perpetuate the name of the class at the Institute in some appropriate manner. The fund is formed from the voluntary subscriptions of the members of the class in any sums, and at any time, and is held in trust by three trustees chosen for life. It is not available for the regular expenses of the class, but its disposition is defined in the Deed of Trust as follows:

III.

DISPOSITION OF INCOME.

The income of the trust fund shall be used as the trustees shall see fit, in one or more of the following ways:

(*a*) To aid any member of the Class of 1887 who may be sick or poor, in such way as the trustees may deem most likely to give such member comfort; or

(*b*) To give to deserving children of the members of the Class of 1887 the advantage of an education at the Massachusetts Institute of Technology; or

(*c*) For such other purposes as, in the opinion of the trustees, will most contribute to the honor and welfare of the members of the Class of 1887; it being intended to leave the use of the income wholly discretionary with the trustees upon the above three lines.

The trustees of the fund are George W. Davenport, Henry L. Bryant, and John L. Shortall. The response of the class to the invitation to subscribe has been generous, though many of its members have yet to be heard

from. — Robert Wilder Bush was married to Miss Caroline C. Cooke, of Philadelphia, on October 29, 1898. — Timothy W. Sprague is a member of the First Corps of Cadets, Co. B. — Lieut. Henry D. Sears is in command of Company E, Massachusetts Naval Brigade. — Fred Thompson was one of two men out of twenty-eight applicants who successfully passed the examination for civil engineer in the United States Navy, and was recently appointed to this office by the President. His rank is that of lieutenant, junior grade, and he has been assigned to the Brooklyn Navy Yard. — Granger Whitney, served throughout the recent war on the cruiser *Yosemite*, as a member of the Michigan Naval Reserve. — (Frank) Gelett Burgess, who has not started a new periodical since the collapse of *L'Enfant Terrible!* last April, is now in London, writing for various English periodicals. He expects to bring out at least three new books next year: "Goop Babies, or, a Manual of Manners for Polite Infants," a series of verses and original illustrations, now running serially in *St. Nicholas*, will probably be published by the Century Company; "The Lively City o' Ligg," a set of modern fairy tales in which the characters are locomotives, pianos, lamp-posts, etc., will probably appear serially in an English magazine; and "Laughing Must I Love Thee," a novel of California life, whose hero, by the way, is a Technology graduate working in a California railroad surveying party, will run serially in the San Francisco *Wave*, and will be published early in the year. Mr. Burgess had a short story, "The Thunder Thief," in the May number of *Harper's Magazine*, and two others are to appear in the *Century Magazine*.

1888.

WILLIAM G. SNOW, *Sec.*
Watertown, Mass.

Edward C. Holton is sergeant, Troop C, First Ohio Volunteer Cavalry. This regiment did not reach the field of battle, but it was sent from one camp in the South to another till one hundred men had dropped out from sickness. — Mr. Edgar F. Dutton, is at Newport News, Va., engaged in the installation of the elec-

trical equipment of the battleships *Kearsarge* and *Kentucky*.— Mr. Arthur Herbert Chester died July 19, 1898. He was connected with the class of '88 during the first year until he left to enter the office of J. Montgomery Sears, Boston, where he remained until his death. He was much interested in church and literary work, was an earnest student of social problems, and was a frequent contributor to a number of papers. He was a member of the Sons of the American Revolution and of the Society of Mayflower Descendants, taking delight in historical study. His sudden death was a severe blow to an unusually large circle of friends. — B. R. T. Collins, of the Illinois Naval Reserves, served on the *Scorpion* during the late war. — T. R. Kimball, was one of the architects-in-chief of the Trans-Mississippi and International Exposition. — Geo. D. Moore, is now a first lieutenant in the Twenty-third U. S. Infantry.

1889.

J. W. CARTWRIGHT, Jr., *Sec.*
Bangor, Me.

Charles N. Borden was commissioned an ensign March 9, 1898, and remained in service until September. — Walter H. Kilham has recently opened an office as architect at 3 Hamilton Place, Boston, and among other buildings is designing a large public school for Beverly, Mass. — Hollis French returned from Europe September 13th, and will deliver his short course of lectures at the Institute on Engineering Practice as usual this year. He has recently become associated with Mr. Allen Hubbard, of Yale Scientific School, the well known steam and ventilating engineer. — A number of the beautiful country places at Dublin, N. H., were designed by John Lawrence Mauran, now of St. Louis, who is about to build one for himself. — The testing laboratory Albert Sauveur has equipped in Boston is particularly adapted for the scientific and accurate chemical and metallurgical work in which he has distinguished himself. Mr. Sauveur edits *The Metallurgist*, which contains valuable contributions to the scientific literature of his specialties. — George C. Wales has been particularly identified, through his firm of Wales & Holt, with a number of very

successful country houses near Boston, though the principal work of his firm has been schoolhouses.

1890.

GEORGE L. GILMORE, *Sec.*
Lexington, Mass.

Charles H. Alden, Jr., is a corporal of the First Corps of Cadets, M. V. M., Co. D. — At the twenty-first convention of the National Electric Light Association in Chicago, June 7th, C. W. Rice read a paper on "The Cost of Generation and Distribution of a Unit of Electricity." — C. W. Sherman, assistant engineer of the Metropolitan Water Works, was married June 23d. — John S. Hyde, with the Bath Iron Works, was married June 4th. — H. P. Spaulding, the artist, was married May 11th, and is now pursuing his studies abroad. — The second reunion of the class of '90 will be held at the Technology Club, Thursday, December 29th. Dinner will be served at half past six, but it is hoped that members will come early in the afternoon and enjoy the benefits of the club.

EDWARD DEXTER BROWN.

On Saturday morning, July 16, 1898, Corp. Edward Dexter Brown, of Troop C, U. S. Cavalry Volunteers, died of typhoid fever in the military hospital at Fort Myer. Those of Brown's classmates who were much thrown with him — the '90 men taking the courses of electrical engineering and physics — loved him well. Looking back at the old three-year campaign that followed the Freshman terms, some of us that were nearest him in spirit recall the "Frau Braun" of those days with a singular clearness. It seems, now, that it may have been the man's winsomeness and spontaneity of nature that attracted us to him as the fellows were brought together by community of studies in the sophomore year; that, and his self-evident fairness of mind and total lack of any capacity for malice or petty jealousy in all phases of student life. What is certain is that that which held his friends to him the stronger the more they knew of him was his essential truthfulness of character. In that particular, at least, his nature was formed once for all by the time he came among us. And so, as he toiled along with the rest through "semies"

and "finals," he was always the quiet, potent force on the side of honor and justice in the little student world which is a miniature of the larger world outside. And all by unconscious example; there never was made a more unassuming man than E. D. Brown. That was his most gentle trait, — that he was a natural gentleman, with the stillest, deepest kind of courage of his convictions. It did not surprise '90 men much, it pleased them all unaffectedly, as they learned of his rapid advancement in business. The little group of his classmates who had tested dynamos with him in the basement of Walker, and pursued the evanescent value of H with him in the advanced laboratory, were personally and distinctly gratified as they learned from time to time how he was being promoted in New York City. It seemed quite natural that he should acquire by great strides the confidence of his official superiors. In three and a half years from the time of entering the American Telephone & Telegraph Co., and four years after graduating, he was made general inspector. We learned about two years ago that he had gone into the militia — a Brooklyn cavalry troop. Then the war with Spain opened, and we heard that Brown had gone with his troop to Long Island, and thence to Virginia. Soon came the news that he was ill at Fort Myer. It was said that he had typhoid fever, but "was getting on all right." So that the news of his death, following only a few days after the announcement of his illness, was a peculiarly sudden grief. It is no use to dwell on the sad details of the loss of such a strikingly useful and amiable life. It is a grim irony that death loves a shining mark. For those immediately concerned seemingly there is little to relieve extinction of such a potent force in the world. But it may be that the grandeur of his end in the service of humanity may balance a long and well spent life, in its effect on the higher aspirations of those whose privilege it was to know him. Such a glorious soldier's death gives a tremendous impetus, in a widening circle, to that which Edward Dexter Brown stood for to the end of his short career, — character. This was the thought of those who had loved him, as they attended the

last earthly offices at his family home at Reading, Mass. After the service in the crowded church, after the procession to the grave under a threatening sky, through the streets of a town stilled for his obsequies, after the honor of the triple volley and the peace of the plaintive soldiers' requiem — "lights out," — behind and above all the last circumstances of poignant gloom rose the thought that is written on the hearts of all those left behind in a sordid world, who knew and loved this young manhood: *Sweet and beautiful it is to die for one's country.*—J. B. Baker.

1891.

Henry A. Fiske, *Sec.*
70 Kilby Street, Boston.

M. W. Greer is on a prospecting tour in Alaska. — At the reorganization of the Norton Iron Co., one of New England's most prominent iron and steel works, W. B. Douglass was made chief engineer and general manager. The new concern is the New England Structural Co. — Jeremiah Campbell is engineer of a large combination of coal dealers in Boston and has charge of all their large barge and steamer interests. — Horace Goodwin has joined the fraternity of bankers and brokers, under the firm name of Goodwin and Thorndike. — H. A. Thompson made the astronomical apparatus taken to Asashi, Japan, by the American College Eclipse Expedition, while apparatus maker for Amherst College. — C. F. Hammond was chief master at arms, U. S. Navy, aboard the U. S. S. *Yosemite*, during the recent war with Spain.

1892.

Prof. Severance Burrage, *Sec.*
Purdue University, Lafayette, Ind.

B. P. Du Bois is passed assistant paymaster on the U. S. S. *Bennington*. — W. H. Messenger is assistant engineer with rank of ensign on the U. S. S. *Cincinnati*. — E. C. Wells is passed assistant engineer, Second Battalion, Naval Militia of Illinois.

1893.

Frederic H. Fay, *Sec.*
60 City Hall, Boston.

A. F. Bemis is a member of the First Corps of Cadets, M. V. M., Co. A. — Charles Wilson Taintor, class president from 1895 to 1897, has recently made a sixteen months' tour of the world. Leaving Boston in

February, 1897, he visited several cities in the Southern States, reached New Orleans in time for the *Mardi-gras*, spent several weeks in California, and sailed from San Francisco in May. In crossing the Pacific he made a short stop at the Hawaiian Islands and then went on to Japan, where he remained five months. His stay in that country was made very pleasant by the attentions of two '93 men, Messrs. Maki and Kato. From Japan Mr. Taintor visited Shanghai, Hong Kong, Canton, and Singapore; spent Christmas in the Island of Ceylon; sailed thence for the Suez Canal, Egypt, and the Nile; made a short tour of Europe; and reached America early in the summer of 1898. In Egypt he ran across George E. McQuesten, who had been married a short time before, and, with his wife, was making the tour of the world in the easterly direction.—In Japan the honors of '93 and the Institute are being ably upheld by Heiichiro Maki and Godfrey Euziro Kato, both of whom are in the successful practice of electrical engineering in their native land. In Kioto, the old capital of the country, Mr. Maki has built the first electric railroad in Japan. Mr. Kato is the chief engineer of the "Suiri-jimusho," or Municipal Electric Works, of Kioto, where, in a large generating plant, water power is transformed into electrical energy, and the power thus generated is supplied to the electric railroad. — Josiah Wilder Howe, of New Haven, Connecticut, is a lieutenant in the second regiment of engineers, U. S. V., which regiment will probably see service in Cuba this winter. Since leaving the Institute, Mr. Howe has held some important engineering positions, chief among them being that of engineer in charge of the design and construction of the Payson Park reservoir and pipe line of the Cambridge, Massachusetts, water works. — Miss Hetty Orilla Ballard, XII. (Geology), the only woman graduate of the class, died at Colorado Springs, Colorado, December 20, 1897. Miss Ballard was a niece of Professor Crosby, of the Institute, in whose family she lived for several years. After graduation, so long as her health would permit, Miss Ballard was assistant in palæontology in the Museum of the Boston Society of Natural History. — William

Wyman Crosby is principal of, and professor of mechanics in, the Lowell Textile School, Lowell, Mass. — Simeon C. Keith, Jr., read a paper recently before the Society of Arts on "Bacteria in Milk: their Function in Butter and Cheese Making." — Frederick Nathan Dillon, president of the class, was married November 9, 1898, to Miss Margaret Downe Morse, daughter of Mr. and Mrs. George F. Morse, Leominster. Mr. and Mrs. Dillon will reside at 33 Summer Street, Fitchburg, Mass.—Edward Samuel Page, of Melrose, Mass., was married June 22, 1898, to Miss Susie May Flint, daughter of Mr. and Mrs. Curtis C. Goss, of Melrose. — The 1898 catalogue of the class of '93 was published in October last. It is a book of fifty-three pages, containing the constitution, list of officers, reports of the annual meetings of 1897 and 1898, a letter from Charles Wilson Taintor, written while on his trip around the world, describing a class dinner of three '93 men in Japan, notes of the Institute, and the class record. The latter has a list of 420 members of the class and gives the addresses and occupations of some 350 of the number. Any member of '93 who has not received this catalogue will have one sent him upon application to the secretary.

1894.

WALTER E. PIPER, *Sec.*
Fells, Mass.

Colbert A. McClure is second lieutenant of the Seventeenth Regiment, Pennsylvania National Guards, Co. D.— John N. Ferguson is a member of the Massachusetts Naval Brigade.— Albert F. Hunt, Jr., graduated last May with the degree of LL. B., from the evening department of the New York University Law School, and incidentally tied a man for second prize. Hunt is practising law, under the firm name of Hunt and Ingle, at 220 Broadway, New York City. — S. F. Thomson has been appointed instructor in topographical engineering at the U. S. Military Academy at West Point. — J. Calvin Locke is an engineer with the department of taxes and assessments, New York City. Previous to June, 1898, he was in the department of health, Brooklyn. — Last February the New Bedford, Martha's Vineyard and Nantucket

Steamboat Company elected Chauncey G. Whiton treasurer and agent of the above corporation. We are pleased to note also that Whiton was married early in October to Miss Harriot L. Cushing, of Hingham, Mass. — L. P. Lane is assistant in the statistical department of the Boston Public Library, and a member of the senior class of the New York State Library School. — A small volume recently published by the Knickerbocker Press of New York City, on the subject of Cuba, is entitled "The Pearl of the Antilles: a View of the Past and a Glance at the Future," by F. M. Noa. — R. B. Price has recently accepted the position of superintendent for the Peoria Rubber Company, of Peoria, Ill. — The Crosby Steam Gage and Valve Co. has expressed its confidence in the ability of Samuel G. Reed, by advancing him to the position of manager of the entire manufacturing department of the company. — Leslie Dana volunteered with Light Battery A, First Missouri Volunteers, went to Porto Rico, was detailed for detached duty under Captain Wainwright on the *Gloucester*, and returning marched with his battery from Arryo to Ponce, where they embarked August 8th for New York, having seen no action. Dana is at present on a sixty days' furlough and says he hopes, after November 20th, to be once more free to pursue the gentle art of stove making.

EDWARD DUTTON CLARKE.

"In the death of Edward Dutton Clarke, son of Mr. and Mrs. Stephen C. Clarke, Buffalo lost one of its brightest and most promising young men. Thousands of persons are saddened by the untimely death. There was probably no young man better known in Buffalo than Mr. Clarke, and none who was more popular, more esteemed. He was born twenty-seven years ago in Buffalo. In 1894 he was graduated from the Massachusetts Institute of Technology, and soon thereafter he entered the employ of Plumb, Burdick & Barnard. He served that firm faithfully, which fact, added to his ingenuity and application, earned for him the position of department superintendent, a place he held up to the time of his death. He was an engineer, both electrical and mechanical, of much skill, and

his employers say that the future held glowing prospects for him. He was a member of the Saturn Club, and was one of that organization's best entertainers. His versatility made him a favorite in any circle. He was also a member of the Buffalo Canoe Club. Mr. Clarke is survived by his parents, Mr. and Mrs. Stephen C. Clarke, of No. 249 Linwood Avenue, his sister, Mrs. E. D. C. Rounds, and two brothers, Townsend Dutton Clarke and Stephen Dutton Clarke."— *Buffalo Express*, Aug. 5, 1898.

1895.

EDWARD H. HUXLEY, *Sec.*
29 Hampshire Street, Cambridgeport, Mass.

Arthur S. Coburn has served on the U. S. S. *Southery*. — John H. Gregory, I., holds a fine position as assistant engineer on the filtration works now being constructed for the city of Albany, N. Y. Mr. Gregory is soon to be married. — Benjamin C. Donham, I., is employed in irrigation work for the Spreckels Sugar Co. — François E. Matthes is a topographic draughtsman for the U. S. Geological Survey, having obtained his position by taking civil service examinations. During the past two seasons as chief of a topographic party, Mr. Matthes has had many delightful chances to see Western scenery. A letter of last September was written from his tent camp situated at an elevation of over 9,400 feet, near Cloud Peak, the highest of the Bighorn Mountains in the Bighorn Forest Reserve, Wyoming. — Gerard H. Matthes, I., also holds a position on the U. S. Geological Survey, obtained by passing civil service examinations. — The Metropolitan Water Board of Massachusetts numbers among its engineering assistants Charles M. Adams, VI.; Sidney K. Clapp, I.; Frederic W. Harris, XI.; George E. Howe, I.; William E. Swift, I.; and T. H. Wiggin, I. The work has offered excellent opportunities for experience in water works on a large scale. — Wallace C. Brackett, XI., has been for some time in the employ of the J. L. Mott Iron Works, in the Boston office. Mr. Brackett was married in February to Miss Florence E. Barker. — Ernest J. Loring, IV., has a very responsible position as superintendent of

construction of the new Masonic Temple, Boston. Mr. Loring had charge, also, of the structural design of the building. — Walter J. Rickey, II., is in charge of mechanical construction in one of the departments of the General Electric Co., at Schenectady, N. Y. — Loren G. Waite, VI., is also employed by the General Electric Co., at Schenectady. — Alfred E. Zapf, IV., is with the American Prism Co., Boston. — Louis K. Rourke has a good position as assistant roadmaster on the Panama R. R. — H. M. Appleton, IX., recently died at his home in Springfield, Mass. — Friends of Charles G. Williams, I., will be glad to hear that he is very much improved in health, and feels able to go to work again. He is at his home in Norwalk, Ohio. — Hugh Tucker, II., went with the Engineering Corps to Honolulu. — J. J. C. Wolfe, II., is in Chicago as chief designer of an oil burner concern. — The annual meeting was held April 2d at the Exchange Club, fourteen men present. The officers elected were Azel Ames, Jr., president; A. L. Canfield and T. H. Wiggin, vice-presidents; and E. H. Huxley, secretary-treasurer. Mr. Huxley was elected to fill the unexpired term, caused by the resignation of R. K. Sheppard, who was unable to continue in office on account of business. The constitution was changed slightly in regard to the method of annual election. Dinner was served, and an entertainment provided by minstrels. — The secretary urges a prompt response to all the notices sent out from time to time, and also a prompt remittance for all dues and assessments, as this is the only source of income, and there are certain necessary expenses. He also especially urges that every member will promptly notify him of any change in address. It is proposed to issue a class book some time during the winter, and interesting information regarding the members of the class is solicited. — Messrs. Azel Ames, Jr., Butler Ames, Kotzchmar, and Tillinghast have been with the army during the Spanish war. Azel Ames is a captain of engineers; Butler Ames is adjutant of infantry; Kotzschmar an engineer in the navy; and Tillinghast a captain of Rhode Island Volunteers. — R. K. Sheppard was married in June to Miss Grace M. Den-

nison, of Newtonville. — F. W. Belknap is in Nicaragua on professional work connected with the canal. — F. A. Hannah has been appointed instructor in drawing at M. I. T., and has a room in the new building. — Charles A. Meserve is studying chemistry at the University in Munich. — Maurice Le Bosquet has been appointed superintendent of W. H. Swift & Co., manufacturers of chemicals. — The members of the class are requested to send items of news of general interest to the secretary for publication in the REVIEW. — R. D. Farquhar has recently returned from Paris, where he has been studying architecture. — Clifford B. Sanborn, while a student in Harvard University Law School, joined a provisional company which was never called into service.

1896.

FRANK E. GUPTILL, *Sec.*
71 Newbury Street, Boston.

Mortimer A. Sears is a member of the Denver City Troop, N. G. R. — Charles Morris, Jr., is assistant paymaster U. S. S. *Hist*, which has been in service off Cuba this summer. — Joseph Hewett acted as first lieutenant in Second Co., M. V. M. — Butler Ames has probably seen as much military service during the past year as any of the members of the class of '96. Ames at the beginning of the war with Spain had a commission as first lieutenant with Light Battery A, M. V. M., but resigned from the battery in May, 1898, to accept the adjutancy of the Sixth Mass. Regiment, which was at about that time mustered into government service. Later, upon the resignation of some of the commanding officers of the regiment, Ames was appointed lieutenant-colonel. While at Camp Meade, and in Porto Rico, Ames, in conjunction with Colonel Rice, was instrumental in preserving the good health of the regiment. — Other members who are connected with military organizations are Walter M. Stearns, a member of First Corp Cadets, M. V. M., Frank E. Guptill, a member of Light Battery A, M. V. M., and Francis M. Conant, private in 142d Separate Co., N. G. N. Y. — W. N. Cabot, of Heath Street, Brookline, is making an extensive stay in Japan, after spending some months on the continent of Europe.

WILLIAM H. KEITH

Was born in Boston, October 7, 1872. Until his twelfth year his home was in St. Augustine, Fla. He was educated by private teachers until he entered the Friends' School, Providence, R. I., in September, 1885. He remained there one school year and then went to "Little Blue" school in Farmington, Maine, remaining there four years. In September, 1889, he entered Thayer Academy, Braintree, and fitted for the Institute, which he entered in 1891. In February, 1895, a serious illness (pneumonia) made a trip South necessary, and consequently he lost a year, graduating with the class of '96. After graduation he went at once to Florida, having a contract to put in the electrical plant in the Hotel Royal Palm, Miami, Fla. The work there was finished about Christmas, 1896. He then went to his old home in St. Augustine, and at once entered with great enthusiasm on a plan of improvement of the large garden and orange grove of which it consisted. This entailed great labor and responsibility, and no doubt overtaxed his strength. In the spring he was elected alderman of St. Augustine. In June a sudden prostration warned him that rest and change were necessary, and he decided to come North for a few weeks. Reaching Boston the middle of August, serious symptoms at once manifested themselves, and a rapid decline of eight weeks was followed by his death, October 17, 1898. At the Institute he was a member of the Southern Club, and president, for his senior year, of the Electrical Engineering Society. He was an excellent student, a good companion, and a firm friend. His classmates mourn him.

1897.

JOHN A. COLLINS, JR., *Sec.*
55 Jackson Street, Lawrence, Mass.

William H. Allen, Jr., is a member of the First Corps of Cadets. — Thomas C. Atwood served as gunner's mate in the U. S. Navy, and Chester D. Hubbard as sergeant U. S. Signal Corps. — Henry M. Loomis is a member of the 142d Separate Co., N. G. N. Y. — Sheldon Leavitt Howard, who was poet on class-day, is at present at Greenville, S. C., with the Fifth Mass. Volunteers. His record is as follows : Enlisted as private

in June, in Co. C., Fifth Mass., then was successively third sergeant, quartermaster-sergeant, and is now second lieutenant. — Mortimer Frank, Course I., is a student in the medical department, University of Illinois. — A. R. Doten, Course II., is employed at the U. S. Navy yard at Charlestown. — Hunnewell and Binley, Course XIII., are in the office of the U. S. Naval Constructor, at Newport News, Va. — Jere. R. Daniell, Course XIII., served in the U. S. Navy as assistant engineer, with the rank of ensign. — William A. Kent, Course I., enlisted as sergeant in the First District of Columbia Infantry. He then became sergeant-major in the Third U. S. Volunteer Engineers, and now holds a commission as second lieutenant in the same company. — Luzerne S. Cowles, Course I., is studying at Geneva, Switzerland. — A. E. Robinson, Course IV., was married on October 11th, to Miss Elizabeth Bowleson, of Chicago. — Edwin S. Dodge, Course IV., is studying architecture at Paris. — John Hastings Howland, Course I., has sailed for Hawaii to engage in business there. — Edwin P. Osgood, Course XI., is one of the government inspectors at the Key West barracks, Key West, Fla. — William E. Reed, Course VI., spent the past year in France, studying with Moisson. His special work is in electro-chemistry, and the direct generation of electricity from coal. — A number of '97 men have been connected with government work during the past year. Among these were Wadleigh, II., who was with the Nicaragua Canal Commission, and Kent, I., who was with the U. S. Geological Survey, in the Black Hills of Dakota. — The second annual circular letter to the class was sent out by the secretary on November 5th. The latter especially desires that the men keep him informed as to their whereabouts. — The annual dinner was held on Saturday evening, December 10th, at The Technology Club. J. Allen W. Jackson acted as toast master.

1898.

CHAS.-E. A. WINSLOW, *Sec.*
Hotel Oxford, Boston.

G. R. Wadsworth is in the employ of the N. Y. C. & H. R. R. R. at Albany, N. Y. — G. F. Ulmer has a position with Ar-

buckle Bros., Pearl St., Brooklyn, N. Y. — D. L. Wing is in the lumber business at Front Creek, Mich. — E. S. Chapin is making a study of the chemistry of wool fats with a Boston firm. — S. F. Jones is studying medicine at the College of Physicians and Surgeons, New York. — E. N. Curtis is studying at the B. U. Law School, and doing a little in the political line. — R. H. Danforth is with the General Electric Company in Lynn. — J. N. Goddard is with the Pueblo Smelting and Refining Company, Pueblo, Colorado. — G. A. Hutchinson is studying machine construction in Milwaukee, in the employ of the Boston and Montana Mining Company. — E. C. Little is with Professor Homer. — W. B. Wood's engagement to Miss Millett, of Beverly, is announced. — R. Allyn is studying patent law in Washington. — A. A. Blanchard, J. G. Coffin, A. I. Franklin, A. H. Jacoby, C. S. Koch, J. C. Riley, E. W. Rutherford, L. J. Seidensticker, and M. de K. Thompson have returned to the Institute as assistants. — J. S. Bleecker, D. W. Edgerly, G. P. Stevens, E. A. Weimer, and C.-E. A. Winslow are taking graduate work at the Institute. — D. Mayer is inspector of the New York and New Jersey Telephone and Telegraph Company. — A. A. Packard is with the Herreshoffs at Bristol, R. I. — C. H. Pease is in the drafting department of the Brooklyn navy yard. — E. F. Russ is with the Baeder & Adamson Company, 143 Milk St., Boston. — E. Sturtevant is teaching in a private school at Newport, R. I. — The engagement is announced of J. H. Lambert and Miss Mabel F. Forrest, both of Course VII., '98. — The following '98 men are known to the secretary to have served in the United States Army and Navy this summer: V. R. Lansingh, private, Second Regiment, U. S. V. E.; W. R. Strickland, ensign, U. S. S. *Bennington;* E. M. Taylor, second lieutenant, First Regiment, U. S. V. E.; H. D. Osgood, private, Fort Riley, Kan.; F. M. Kendall, sergeant, Sixth Massachusetts Volunteers; H. Snelling, corporal, First Regiment, U. S. V. E.; E. R. Springer, captain, Fifth Massachusetts Volunteers. — There is a little settlement of '98 men in Chicago, including H. L. Cobb, R. S. de Golyer, L. D. Gardner, P. McJunkin,

W. A. Marshall, H. E. Sargent, Jr., A. R. Shedd, T. E. Tallmadge, R. S. Willis, and W. G. Zimmermann. — The first Tuesday in every month is '98 night at the Club, and all who have ever been connected with the class are urged to drop in. The first two meetings were enjoyed thoroughly by those who found time to be present.

NECROLOGY

1872. William B. Dodge, b. June 4, 1851, in Beverly, Mass.; d. in Columbus, Ohio, January 29, 1898.

1888. Arthur Herbert Chester, b. February 3, 1868; d. July 19, 1898.

1890. Edward Dexter Brown, b. August 29, 1868; d. in Fort Myer, July 16, 1898.

1893. Hetty Orilla Ballard, b. June 18, 1868; d. in Colorado Springs, Colo., December 20, 1897.

1894. Edward Dutton Clarke, b. June 22, 1871; d. in Buffalo, N. Y., July 30, 1898.

1896. William Henry Keith, b. October 7, 1872, in Boston; d. in Boston, October 17, 1898.

PUBLICATIONS OF THE INSTITUTE

This supplement to the Register of Publications, published in 1893, is prepared in compliance with the vote of the Alumni Association in December, 1897. Owing to the lack of time previous to going to press, no opportunity has been offered to search the literature for those who made no reply to the requests of the secretary to transmit the titles of their publications. It is therefore probably somewhat incomplete. A. H. G.

1893–94 to 1898. Annual Catalogues of the Officers and Students with a Statement of the Courses of Instruction and a Register of the Alumni. Pph. 8vo. Boston, 1893–98.

1893 to 1899. President's Reports for the years ending December, 1893–98. Boston, 1892–98.

1893. Department of Civil Engineering. Pph. 8vo., pp. 22. Boston, 1893.

1893. Department of Chemistry. Pph. 8vo., pp. 15. Boston, 1893.

1893. A List of Periodicals and Society Publications in the Library of the Institute. Pph. 8vo. 2d Edition, Boston, 1883.

1894. The Micro-organisms of Fermentation. Pph. 8vo., pp. 12. Boston, 1894.

1894. Choice of Courses. Circular, pp. 4. Boston, 1894.

1894. Directory of Buildings. Circular, pp. 4.

1895. Massachusetts Institute of Technology. A brief Account of its Foundation, Character, and Equipment. Pph. 8vo. Boston, 1895.

1895. Catalogue of the Premiated Drawings of the Department of Architecture. Pph. 8vo., pp. 50. Boston, 1895.

1895. Department of Architecture. Pph. 8vo., pp. 28. Boston, 1895.

1895. Five Year Courses. Pph. 8vo., pp. 6.

1895. Opportunities for Teachers. Pph. 8vo., pp. 19. Boston, 1895.

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REVIEWS

The Technology Quarterly for December will contain: "On the Production of Illuminating Gas and Coke in By-Product Ovens," by H. O. Hofman; "The Normal Chlorine of Jamaica," by Ellen H. Richards and A. T. Hopkins; "An Improved Filter for Microscopical Water Analysis," by Daniel D. Jackson; "The Acetylene Standard of Light," by H. E. Clifford and J. S. Smyser; "Modification of Bischof's Method for Determining the Fusibility of Clays," by H. O. Hofman; "Does the Size of Particles Have any Influence in Determining the Resistance of Fire Clays?" by H. O. Hofman and B. Stoughton, and "Review of American Chemical Research."

MATTER, ENERGY, FORCE, AND WORK

A Plain Presentation of Fundamental Physical Concepts, and of the Vortex-Atom and Other Theories. By SILAS W. HOLMAN, Professor of Physics (Emeritus), Massachusetts Institute of Technology. Published by the Macmillan Company.

Perhaps no topic has been the subject of more discussion during the last few years than that relating to the proper method of treat-

ing physical and chemical laws and phenomena. Two radically different methods are in vogue, the so-called Energetic and Kinetic Methods, the former seeking to deduce all laws from the two energy principles without the aid of hypothesis and theory; the latter attempting to refer all phenomena to, and to explain them by, some form of mechanical conception. The discussion has been confined for the most part to eminent German scientists, and it is therefore with a feeling of especial pleasure that we greet the appearance of a contribution bearing on this subject from the pen of one of our ablest and most original thinkers.

The book which Professor Holman has given us is not intended as a critique of the above mentioned schools, but is, as the author states in his preface, constructive rather than critical in spirit, and purposely almost devoid of historical and personal allusions. The author's own originality impresses one from beginning to end. His aim has been to develop the fundamental concepts of physics logically step by step from as few assumptions, and in as simple a manner, as possible. Conclusions based on hypothesis and theory are always kept clearly distinct from those resting on indisputable evidence, and although the author evidently inclines strongly toward the voxtex-atom theory as a step toward the ultimate explanation of matter and energy, yet never does he permit conclusions from this theory to appear other than as consequences of an unproved and unprovable hypothesis. The book may therefore be read by a student without fear lest certain alluring hypotheses and theories take root in his mind as accepted realities, — a thing which, unfortunately, cannot be said of many of our modern text-books.

So numerous are the lines of thought suggested by a careful reading of the book that a brief review can but very inadequately indicate the real extent of its contents. It should be read by teachers, students, engineers, and all others who would gain clear ideas of many concepts, which current literature shows to be far from generally understood.

The work is divided into two parts; the first, which deals with the subject proper, is devoted to the discussion and development of the fundamental concepts indicated in the title; the second is

devoted to a plain exposition without mathematics of the chief theories of the nature of matter, energy, and force.

As a starting-point, the author takes the cognizance which we have through our senses that space about us is divided into definite regions, capable of affecting our senses and each other, and possesses definite properties or "powers." It is inferred, therefore, that there must be in space something endowed with these powers, and this is defined as *Substance*. Whether Substance can or cannot exist after the removal of some or all of the powers by which we recognize phenomena, and whether a power (form of energy) can exist apart from Substance, is left open by the definition itself. To provide for the former possibility the concept of Matter is introduced, Matter being defined as *the inert constituent of Substance*; inert is here used in the sense of devoid of all "powers." The usually accepted definition of Mass then follows; *Mass is quantity of Matter*.

It will be seen from the above definitions that Ostwald's view — that Matter is only an aggregation of different energies ("powers") and has no independent existence apart from energy — is not advocated. This view is that probably held by the majority of physicists at the present time.

The concept of Energy is next considered. This is prefaced by a short chapter on Motion, considered in the kinematic sense, in which excellent definitions of velocity, acceleration, and other terms necessary for a clear comprehension of Newton's Law of Motion are given. This law is stated as follows: The *State of Motion of any Body remains constant, except in so far as changed by external action*; or, *All observed changes in the state of Motion of bodies are due to discoverable external action*. Taking this as a fundamental law of Nature, verified by all experience, the author then defines Energy as follows: *Energy is Power to Change the State of Motion of a Body*.

This definition, which departs from that usually adopted, is discussed at length both here and in a later chapter. The advantages claimed for it are its definiteness, the ability to recognize by means of it everything that is energy, and ultimately to recognize all

forms of energy, the possibility of basing on it a primary method of energy measurement, and its simplicity for the beginner. It is distinctly stated that it in no way assumes all forms of energy to be kinetic in their nature, only that all forms may be made to produce motion. Although much may be said in favor of the concreteness of the above definition, and the greater tangibility of the concept for the beginner over the more general statements of energy based on the principle of its conservation, yet as this principle must be recognized as the great generalization upon which all energy transformation rests, it seems scientifically more logical to take the Principle of the Conservation of Energy as the starting-point, and make Newton's Law of Motion follow as a consequence. Upon this point, however, there is much diversity of opinion. Referring energy in its definition back to motion gives such prominence to kinetic energy, compared with other forms, that the student, reading a less discriminating writer than the author, might very easily be led to conceive all energy to be essentially kinetic in its nature, — a view which is fatal to sound scientific thought.

By means of the above criterion for energy the following classification of all forms of energy now known is made:

1. Kinetic Energy.
2. Gravitation.
3. Heat.
4. Energy of Elasticity.
5. Cohesive Energy.
6. Chemical Energy.
7. Electric Energy.
8. Magnetic Energy.
9. Radiant Energy.

The prominence given to Energy of Elasticity, both here and throughout the volume, is especially noteworthy, for notwithstanding the frequency with which this form of energy enters into all transformations, it is usually completely ignored, since it acts for the most part only intermediately between the initial and final transformation.

The Concept of Force is next considered, *Force* being defined as *that Action of Energy by which it Produces Tendency to Change in State of Motion of Bodies.* (Rest is understood to be a special case of Motion.) The essentially secondary nature of this concept as

being only a manifestation of energy is strongly insisted on, and clearly brought out, and this chapter, especially, might be read with much profit by many writers of elementary physics. Force as thus defined is a much more general concept than that adopted by some recent writers who restrict the use of the term to the intensity factor of energy existing between two bodies in virtue of their position (distance or gravitation energy.)

It seems to the reviewer desirable that this concept should embrace the intensity factors of cohesion and elastic energies, that is, force distributed along a line, and over an area, as the author has done, but the advisability of extending the term to other than these factors of mechanical energy is open to serious question. The author states in a discussion of this matter in a later chapter that it is not to be inferred from the definition that all forms of energy do exert force, but the impression left after reading the book is that they may do so. But how, for example, heat energy, equal always to a temperature times a heat capacity or entropy, can itself exert a force, as above defined, without being first transformed into elastic energy, is not clear. This chapter on force contains an excellent discussion of the nature of resistance in the case of both solids and fluids.

The measurement of Kinetic Energy is next considered. A spring buffer apparatus is described by which the kinetic energy of a body may be stored indefinitely as elastic energy, and afterwards imparted to other bodies, and the relations holding between velocity and the other quantity or capacity on which kinetic energy depends, quantitatively studied. This second factor, the capacity of a body for kinetic energy, is given a new name, *kinergety*. The author finds justification for introducing this new term for what is universally denoted by Mass, in the independence of the concepts of Energy and Matter as defined. The strict proportionality between these two concepts, as in the case also of weight and mass, does not signify their identity, and the systematic use of the term kinergety throughout the book, in the sense defined, certainly adds clearness to the treatment when once one has become accustomed to its use.

The quantitative discussion of Energy leads naturally to the

principle of its transference and conservation, which is stated as follows: *When any quantity of energy of one form disappears, a precisely equal quantity of energy simultaneously appears in some other form or forms.* The mutual transformation of different pairs of energies is illustrated by numerous examples and the intervention of elastic energy in all cases pointed out. Here also is considered the question, "Does all Energy exert Force?" The principle of the dissipation of energy is dismissed with a brief statement. We cannot repress the hope that the author may sometime see his way to publish his views on this principle, and the general question of the direction of natural processes and the second law of thermodynamics.

Work is next considered, and defined *as any process of transference or transformation of energy.* Numerous illustrative examples are considered, and the units in which different kinds of work are expressed are discussed. *Power is defined as the time-rate of the performance of work.*

The chapter devoted to a discussion of force measurement embraces its primary measurement based on its definition, — that is, the space-rate of transference of energy, and its measurement by a spring and equal arm balance. The evidence on which the assumed proportionality between weight, kinergety, and mass rests is very clearly stated. A new term is also proposed for designating the quantity of any substance weighed on an equal arm balance. It is suggested to call this a *weightal* as distinct from weight or mass, the terms now universally, but often indiscriminately, employed. Weightal is defined to express exactly what is obtained when a body is weighed with an equal arm balance, and thus obviates the well-founded objection advanced by physicists to adopting the term weight, which is strictly a force, and the less founded objection advanced by chemists to adopting the term mass, when speaking of combining, and atomic "weights" and "masses." The objections raised to both of these terms are in a sense legitimate, and if general usage will sanction and adopt the proposed term, *weightal*, greater uniformity, if not clearness of expression, will result.

The concept and use of the expression, Potential Energy, which has introduced so much ambiguity in the past, is discussed in a chapter by itself. As demonstrated by its absolute omission in the whole of the preceding discussion, the term is not a necessary one, although it is so deeply rooted in current phraseology that it will probably long remain in use. The author holds that, if used, the term "Potential Energy" should be used only in the sense of energy "potential to" the system in question in its given condition.

The very interesting chapter on Matter cannot be adequately reviewed in a few words from the philosophical nature of the discussions involved. It need only be stated that a consideration of the possible properties of matter leads to the conclusion that matter is probably devoid of all properties associated with substance (including even the capacity for gravitation energy), with the possible exception of kinergety. This is the one positive property required of the hypothetical fluid on which the vortex-atom theory is based.

The final chapter of Part I. is devoted to a critique of current definitions of Matter, Energy, and Force.

Part II. contains a clear statement of the kinetic theory of gases, of Le Sage's theory of Gravitation, and of Kelvin's Vortex-atom theory. The statement of this latter theory is particularly valuable, as a clear exposition, free from mathematical details, is difficult to obtain. Extracts from personal letters to the author from Lord Kelvin and Prof. J. J. Thomson are very interesting in this connection. The former no longer regards a mere configuration of motion sufficient to explain the nature of an atom, while the latter still holds that such a theory is the goal toward which to strive.

The concluding chapter on the Nature of Energy and Matter is original, and largely speculative. A theory of Chemical Energy based on Le Sage's and Kelvin's theories is suggested. But fascinating as speculations on such hypotheses may be, the author never permits them to advance beyond their legitimate sphere, and to assume the rôle of facts. It is this keen appreciation of the real value of hypotheses and theories in scientific research, and the

recognition of their only legitimate use as temporary structures by which to explain and predict experimental facts, which stamps the seal of the true scientist on every page of this book. The work is a valuable contribution to physical literature, and we heartily congratulate the author upon its completion.

The work is dedicated to the Massachusetts Institute of Technology, to the members, past and present, of its Corporation and Faculty, and to the Alumni.

H. M. Goodwin, '90.